ANNUAL REPORT

OF THE

DEPARTMENT OF AGRICULTURE,

BOMBAY PRESIDENCY,

FOR THE YEAR

1909-1910.

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1910

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No. A.-7828 of 1910.

From

G. F. KEATINGE, Esq., I. C. S.,
Director of Agriculture, Bombay,
Poona;

To

The CHIEF SECRETARY to GOVERNMENT,
Revenue Department, Bombay.

Poona, 1st November 1910.

Sir,

I have the honour to submit herewith the Annual Report of the operations of the Agricultural Department for the year ending June 30th, 1910.

CHAPTER I.

Administrative.

2. The principal posts in the Department have been held as follows during the year:—

Director of Agriculture—Myself, throughout the year except for one month's privilege leave.

Principal, Agricultural College and Agricultural Chemist—Dr. H. H. Mann, throughout the year.

Professor of Agriculture—Mr. J. B. Knight, throughout the year.

Economic Botanist—Mr. W. Burns, throughout the year.

Deputy Director of Agriculture, Bombay Presidency—Mr. T. F. Main, throughout the year.

Deputy Director of Agriculture in Sind—Mr. G. S. Henderson, throughout the year.

Agricultural Engineer—Mr. A. A. Musto, from November 29th to June 30th.

Divisional Inspector of Agriculture, Northern Division—Mr. B. M. Desái, throughout the year.

Divisional Inspector of Agriculture, Southern Division—Mr. M. L. Kulkarni, throughout the year.

Divisional Inspector of Agriculture, Central Division—Mr. P. C. Pátil, throughout the year.

Divisional Inspector of Agriculture, Konkan—Mr. V. H. Gonehalli, from January 11th to June 30th.

While in Sind Mr. Gul Mahommed retained his post of Inspector of Experiments.

The Superintendents of Farms also have remained practically unchanged; so there has been no break in the continuity of the work.

3. The staff and work of the Agricultural College has been fully dealt with by the Principal in his report which is printed in this compilation, together with my review of the same.

4. The principal additions to the staff have been—

(*a*) Mr. G. D. Mehta, who has been temporarily posted to the Agricultural College for research and teaching work;

(*b*) Mr. S. L. Ajrekar, who has taken up the post of Assistant Professor of Mycology;

(*c*) Mr. V. H. Gonehalli, who has been posted as Divisional Inspector of Agriculture in the Konkan.

The return of these three men from Cambridge leaves Mr. P. J. Bhat as the only Government scholar studying in England in connection with Agricultural work.

5. Mr. G. S. Kulkarni, who was studying Mycology at Pusa, returned in the month of April 1910 and has been posted as a Mycological fieldman. We have now no student studying at Pusa.

6. We have supplied trained Agricultural Officers from our staff to the following Native States, *viz.*, Baroda, Pálitána, Bálásinor and Sángli. These States have all undertaken the work of agricultural development, and have established experimental stations. As against these losses of staff we must set off the acquisition of Mr. G. N. Desái, who went to Pusa with Mr. Mollison some years ago, and has now returned to this Presidency, and been posted as Superintendent of the Muvália Farm.

7. The farms at Sukkur and Gokák, which were taken in hand during the previous year, are now getting into shape and will soon be available for purposes of investigation. They are already serving as centres for departmental work, and the distribution of seed and implements.

8. It is proposed to open an agricultural station very shortly in the Kolába District to investigate the best method of maintaining and improving the fertility of rice lands. This will supply our most pressing need; for we have at present no farm in the Konkan. Proposals have also been made and sanction received to open a farm at Lárkána in Sind. The only large tract which will then remain without an agricultural station will be the East Deccan; and it will be for future consideration whether we should establish a permanent station in this locality or should be content with the temporary plots on which we are at present conducting experiments in this region.

CHAPTER II.

The year's Work on the Farms.

9. The summaries which are appended to this report contain a good account of the work that is being done in this respect; and the farm reports give full details; so I propose to refer to the subject only in general terms. There has been no noteworthy departure in this branch of the work, but rather a continuation and development of the previous year's work.

10. *Seed.*—Varietal tests, hybridization and seed selection has been continued and extended.

11. As a result of previous year's work we have now got to the stage of distributing on a large scale cotton seed as follows:—

(*a*) Selected seed of Broach cotton, in Dhárwár and Belgaum.

(*b*) Seed of hybridised Kumpta cotton, in Southern Marátha Country.

(*c*) Selected and hybridised seed, round Surat.

(*d*) Selected seed of the most profitable ingredient (Neglectum Roseum) in the Khándesh mixture, in Khandesh.

(*e*) American cotton seed, in Sind and on a smaller scale we are distributing Cambodia cotton seed in the East of the Dhárwár District.

The advance in the cultivation of Broach cotton in the Southern Marátha Country due to our seed distribution may be realised from the following figures of the value of Broach cotton sold at our annual auction at Dhárwár:—

Auction sale.	Year.	Value of Cotton sold.
		Rs.
No. I	1908	8,398
No. II	1909	47,926
No. III	1910	1,11,455

These figures are, of course, exclusive of Broach cotton sold privately by cultivators. The extra profits of Broach cotton cultivation over Kumpta cotton were realised this year as in previous years, though the violent fluctuations of prices about the time of our auction tended to obscure this fact. For quality alone the produce of our hybridised Kumpta fetched at the Dhárwár auction

a price 7½ prceent. above ordinary Kumpta and the produce of selected and hybridised seed from the Surat Farm distributed round Surat fetched a price 5 per cent. in excess of the price for local cotton, without the help of any auction. Apart from the extra price obtained for the quality of these cottons, the yield from our seed was certainly in excess of that obtained from ordinary seed; and the cultivators' appreciation of this fact is shown by a keen demand for our seed.

12. Seed of various groundnuts was distributed on a very large scale in Southern Gujarát, Khándesh, Deccan and Southern Marátha Country, and a small amount was distributed tentatively to many people in the Konkan. The seed is plentiful now in many localities, and where it is not plentiful, there is a large demand for it.

13. Sugarcane sets were widely distributed from the Mánjri Farm; much seed of cereals and pulses was sold, and potatoes were pushed where they offered prospects of success.

14. Apart from the technical difficulties of discovering or developing a constant strain of improved seed in the case of any crop, there are two economic difficulties which have to be faced before this line of work can be productive of great value. The first difficulty lies in the fact that the market is seldom very sensitive of quality. Expert dealers in Bombay may affirm that one kind of cotton or wheat is worth 20 per cent. more than another; but it is quite another thing for the cultivator to get it. By auctions and otherwise we do in some cases attempt to obtain fair prices for crops grown at our recommendation; but such intervention on our part is not susceptible of unlimited extension. Unless the cultivator can get a better price for better quality, he will naturally prefer quantity, and our efforts too will have to be primarily directed that way. A second difficulty lies in the fact that the cultivator is seldom careful to retain good seed for future use. The careful analysis of the cotton crops grown all over the Presidency which Mr. Main publishes in his farm reports, show how extraordinarily mixed cotton is. We may go on separating varieties; but if it is all going to be mixed up again every year at the gins we shall never get much further; while any new variety that we may introduce will merely be a fresh ingredient in the existing mixture. The same is the case with jowári in many parts. No doubt something can be done to face these difficulties, and we propose to do what we can; but I merely mention them to show that our work does not end when we have developed an improved strain of seed, or when we have introduced it, or even when we have marketed the produce for the growers.

15. *Manure.*—It is with *irrigated crops* that the question of manure is most important. This year's experiments at Mánjri indicate that the most economical top dressing for sugarcane is a combination of safflower cake and Ammonium sulphate; while apparently our standard application of nitrogen is capable of reduction without reducing the crop. Experiments in manuring sugarcane were extended to the saltish lands on the Nira canal, and to the land under well-irrigation in the Sátára District, and useful indications were secured. For irrigated tobacco the advantage of a top dressing of castor cake was confirmed, and nitre did well for rice. Safflower cake combined with farmyard manure gave good results with potatoes in Belgaum. The cost of farmyard manure is comparatively high in many garden tracts; but for most purposes it is still the cheapest fertiliser available.

16. *As regards unirrigated crops on black soils situated in a region of good rainfall* such as Surat and Dhárwár our manurial experiments are leading to definite results. Good black soil which is well cultivated will continue to give a good outturn though unmanured for years. Land unmanured for at least 13 years and without any leguminous crop in the rotation yielded at the rate of 1,135 lbs. of jowári and 332 lbs. of seed cotton per acre. Still a fair application of farmyard manure produces a good addition to the crop, and is about the most profitable dressing that can be given at present prices. Poudrette, however, is an excellent substitute for farmyard manure. The extraordinary stimulation of crops by the application of crude night-soil is again made evident, and its residual value in the plots so treated at Surat six years ago is most marked. As regards mineral manures it is clear that by their use the yield can be largely increased. This is most marked in the case of cotton, which can be stimulated to

the extent of 30 per cent. by an application of superphosphate and nitrate of soda. Nitre too gives good results. At present average prices, however, the increased yield barely pays the cost of these manures for dry crops, and they cannot be recommended to cultivators. The information, however, which we are obtaining is of considerable value, and, given a rise in the price of produce or a fall in the cost of these artificials, their use would become remunerative. An interesting experiment was conducted on unirrigated tobacco in the Sátára District by Mr. Paul Fredrichsen, the representative of a German Potash Syndicate, and himself a skilled tobacco grower, with the assistance of this Department. A manurial treatment was given consisting of green manure, 315 lbs. superphosphate, 240 lbs. of Ammonium sulphate and 220 lbs. Sulphate of Potash per acre, which, it is claimed, stimulated the crop to the extent of 50 per cent., and left an additional net profit of Rs. 47-9-9 per acre. Further investigations will be made in this matter.

17. *In tracts of light and precarious rainfall* the question of manuring unirrigated crops is more difficult, and we have as yet little precise information about the matter, since we have no regular farm in such a tract devoted to dry cultivation. Many cultivators are of opinion that manure cannot be profitably applied in such tracts, saying that it "burns the crop," but I think that there can be little doubt that light applications judiciously applied will give profitable results in the long run, while in years of exceptionally heavy rainfall when, as sometimes happens, the crops suffer in heavy soils from too much moisture, nitrogenous top dressings would probably give good results. These, however, are problems for the future; and it must be recognised that the question of manure is of relatively small importance in the dry tracts, as compared with the question of cultivation.

18. *Cultural Experiments.*—A number of cultural experiments have been tried on the farms, and in particular the results of deep ploughing as against shallow ploughing or mere harrowing have been tested. In some cases the deep ploughing was done immediately or shortly before sowing, and neither a good state of tilth nor a firm seed bed had been produced. Under these circumstances, the results of deep ploughing were not favourable. The subject of cultivation is one of which we have made little systematic study but is of the greatest importance in this Presidency. Experience shows that the black cotton soils will give good crops with little or no manure. Even rotations do not appear to be of very great importance in all cases. But I think that there can be little doubt as to the paramount importance of good cultivation and the necessity for systematically studying the subject. The question has several sides. In the first place there is the necessity of getting the land free from weeds and in particular from deep rooted permanent weeds such as hariáli and kunda. When, as on our farms, land is free from these weeds and in a fair state of cultivation, it may be open to question whether it will pay to plough deep every year, or even every alternate year; but it needs no demonstration of ours to show that it is essential to plough deep to eradicate deep rooted weeds. Unfortunately there are large tracts in the Eastern Deccan and Karnátak where it would hardly be exaggerating to say that of the good land one-third is rendered useless by such weeds, and in another third the crop is seriously injured by them. Under such conditions considerations of seed and manure are of little moment; for little of the seed will fructify, and manure, if applied, will chiefly serve to stimulate the weeds. Given clean land, however, two further questions arise, namely, the state of tilth that it is desirable to obtain, and the best implements for obtaining it. Herein lies a study of much importance which it must be our object to systematically pursue. Local practice in this matter varies very greatly even in small areas, and will probably give useful indications of the tilth desired by cultivators; though they seldom realise their desires owing to the primitive nature of their implements. A commencement of such work has been made with "dry farming experiments" at Ahmednagar, but we have hitherto obtained very few results, and it is not likely that any satisfactory results can be obtained until we have far more time to devote to the matter. Apart from particular investigations of this kind, the whole question of farm mechanics requires careful study. The simple implements of this country may have done their work well for centuries past; they are certainly cheap and easily repaired; but they are certainly not

efficient according to the modern standard, as set by the existence of cheap iron, and introduced into all Western countries during the past century. This I regard as the most important line of work for our black soil tracts when we can find the men and money for the purpose.

19. In connection with tillage too, must be considered the important problem of the supply of plough cattle; of breeding, rearing and feeding them. I have already expressed my views on this subject.

CHAPTER III.

Demonstrations, Shows and District Work.

20. It is in this direction that there has been the most marked increase of work. During the year under report, an Agricultural Conference and Exhibition was held in Poona. In the Presidency Proper, 15 Agricultural Shows and 10 Demonstrations on the Farms were held, and in Sind 2 Shows and 49 lectures and demonstrations; while a great deal of itinerant demonstration was undertaken by the Divisional Inspectors and the fieldmen who served under them.

21. The Proceedings of the Conference have been published; I have submitted my remarks to Government on the suggestions made, and orders have been passed on the subject, so it is only necessary to refer briefly to the matter. We invited the criticisms and suggestions of the public on our work, and the following were the points of most importance raised by the discussion :—

(*a*) The difficulty of providing sufficient fodder for plough cattle, cows and young stock.

(*b*) The demand for agricultural education for cultivators' sons.

(*c*) The desire for a vernacular periodical dealing in a practical way with agricultural questions.

(*d*) The desire that we should largely increase our demonstrations, and establish a large number of depôts for seed, implements and concentrated manures all over the Presidency.

As regards (*a*), we realise the importance of the subject and have made tentative steps to study it more systematically; and proposals have been made to Government for the development of this line of work. As regards (*b*), we have since established, as an experimental measure, an agricultural vernacular school, which is fully described on page 24 (*post*). As regards (*c*), a monthly journal in Maráthi called "Shetki ani Shetkari" has since been started in Poona under the auspices of the Deccan Agricultural Association. Dr. Mann and Ráo Sáheb G. K. Kelkar, Assistant Professor of Agriculture, are two of the editors, and Government has given a standing order for 1,000 copies for distribution. As regards (*d*), it will be shown below that we have greatly increased our demonstration work. The distribution of seed, implements, etc., is steadily increasing; but I doubt whether it will ever be possible or desirable for this Department to undertake a huge retailing agency throughout the Presidency as seems to be suggested. A point must be found where private enterprise can take up this work. It will certainly be difficult to find individuals ready to undertake such a business; but our best chance of success lies in this direction.

22. Of the Shows held, those at Jalgaon, Sholápur and Godhra were District Shows organised mainly by District officers; those at Ahmednagar, Nevása, Yeola, Bárámati, Peth (Sátára District), Panvel and Ratnágiri (Ganpati Pula) were organised by the local Agricultural Associations; those at Ahmedabad, Talhár and Shikárpur in connection with annual horse or cattle fairs; one at Kulgod in connection with the Reddy Conference, and one at Broach in connection with an exhibition of art and industry. The show at Sukaltirth was organised in connection with the fair held there by an enterprising Pátidár, Mr. Antolbhai

Jorábhái, who put himself to a good deal of expense in the matter. At Kolhápur we merely assisted a show held in connection with a fair and conference at that place. In all these cases the work done by the staff of this Department was considerable, and in the Deccan where eight shows were held within a short period the strain on them was great. Different members of the staff, often quite junior, were put in charge of the organisation, and they acquitted themselves exceedingly well, and gained much experience thereby; but it was inevitable that the work on the farms should suffer somewhat when the staff were withdrawn for long periods from their ordinary work. At the shows there was in most cases an exhibition of local produce for which prizes were awarded, and an exhibit of produce put up by this Department.

Implements were shown by us, and demonstrations and lectures were given.

23. The more important points which we dealt with at these shows were—

(1) The necessity for clean cultivation and good tilth.
(2) Proper rotations.
(3) Straight sowing, thin seeding and proper spacing.
(4) The importance of good seed.
(5) The preservation of farmyard manure.
(6) Care of cattle and the maintenance of a fodder supply.
(7) Economy and efficiency in gul making.
(8) Nitrogenous top dressings for sugarcane.
(9) Plant diseases and insect attacks.

Amongst the implements displayed were improved ploughs, harrows, clod crushers, rollers, levellers, water-lifts, cane crushers, hand gins, corn shellers, threshers, winnowers, mowers, and chaff cutters. Amongst other demonstrations were the Poona system of gul making, the manufacture of poudrette, grafting and eri-culture. Leaflets were distributed after lectures and demonstrations; and I think that a good deal of interest was created amongst the large number of persons who attended these shows.

24. The ten farm demonstrations in the Presidency proper took place at :—

Number.	
2	Poona (College farm, Botanical garden and Mánjri).
1	Surat.
1	Dohad.
1	Nadiád.
1	Dhulia.
1	Gokák.
1	Belgaum.
1	Dhárwár.
1	Gadag.

At these demonstrations landholders and cultivators are invited to attend and to witness the farm crops, the results of experiments, and the system and implements used on the farm. They are certainly gaining in popularity and any number of persons up to 600 now attend. After part of the demonstration has been held in the morning the visitors are given a meal on the farm about midday, after which they discuss matters of interest with the farm staff before the demonstration closes in the evening. These meetings are of much use and afford good opportunities for discussion, and the establishment of friendly relations between the staff of this Department and the most progressive cultivators.

25. This is the first time that the three Divisional Inspectors for N. D., C. D., and S. D. have had a complete year at their work, and I am glad to be able to report that they have made good use of their opportunities and taken up their new duties very keenly. They have been the moving spirits in the Shows

and Demonstrations, and have made active tours throughout their charges bringing to the notice of cultivators in their own homes matters which are of much importance to them. They have now established relations with leading cultivators in their charges and are freely consulted on many matters, so much so that their correspondence is already becoming large.

26. In the Northern Division Mr. Bhimbhái arranged for the distribution of the seed of hybridised and selected cotton from the Surat Farm, kept an eye on its cultivation and arranged for its marketing. He popularised groundnuts and provided good wheat and potato seed in many parts. An important part of his work lay in showing to the Khándesh cultivators superior Gujarát methods, and in particular in bringing to their notice the Olpád wheat thresher whereby 3 men and 2 bullocks can do the work of 6 men and 18 bullocks.

27. In the Central Division Mr. P. C. Pátil continued his work of popularising the Turn-wrest Plough, his demonstrations of the efficiency of the Poona furnace in gul making and the value of nitrogenous top dressings for sugarcane. He opened up new ground in the Sholápur District and preached the necessity for cleaner cultivation with energy and success. Turnwrest ploughs have become quite popular in some localities, and I should estimate that about 1,000 were sold in the Deccan and Southern Marátha Country last year. I am informed that in the Nira valley alone there are over 500 now at work. In the Sátára District many cultivators have adopted the Poona furnace and top dressings for sugarcane. Groundnuts were distributed on a large scale, and selected cotton and wheat seed to some extent.

28. In the Southern Division Mr. M. L. Kulkarni introduced Broach cotton into new areas, and instructed the people in its cultivation. He also introduced selected Kumpta and Cambodia cottons into suitable localities. He was very energetic in demonstrating improved methods of gul-making, which cost less than those employed locally, and in many instances produce gul which fetches 12 per cent. more in the market. He induced many cultivators to dress their jowári seed with sulphate of copper as a preventative against smut, originated some useful work in connection with the supply of potato seed and organised the cotton auction at Dhárwár.

29. Mr. V. H. Gonehalli, who joined his post in the Konkan in the middle of the year, acquainted himself with his charge and developed his plans for future work.

CHAPTER IV.

Publications.

30. The following publications were issued during the year :—

Bulletins.

(1) Bulletin No. 35 of 1909 on "Kalar in Sind" by Mr. G. S. Henderson, Deputy Director of Agriculture in Sind.

(2) Bulletin No. 36 of 1910. "The first experiments in the treatment of Grape-vine Mildew in the Bombay Presidency" by Mr. W. Burns, Economic Botanist.

(3) Bulletin No. 37 of 1910. "An examination of the seed supply of the Broach District" by Mr. G. D. Mehta.

(4) Bulletin No. 38. "Experiments with the Water-Finder" by Mr. H. K. Mehta.

(5) Bulletin No. 39. "The Salt Lands of the Nira Valley" by Dr. H. H. Mann and Mr. V. A. Támbane.

Leaflets (with vernacular versions).

1909.

(1) The Scum Strainer in Gul-boiling.
(2) Note on Eri Silk.
(3) The Destruction of Grasshoppers.
(4) Smut Disease of Jowár and Wheat.
(5) Chaff Cutters.
(6) Guinea Grass.
(7) Preparation of Turmeric for the Market.

1910.

(8) The Red Rot of Sugarcane.
(9) Groundnuts—Cultivation of Spanish Peanuts.
(10) Groundnut Culture in the Konkan.
(11) Lucerne—A Valuable Green Fodder.
(12) A Feeding Meal from the Scum obtained in Gul-boiling.
(13) Guinea-worm.

31. Each of the five bulletins mentioned is a record of careful investigation and a valuable contribution to our existing knowledge of the subjects dealt with. Nos. 1 and 5 give practical suggestions for dealing with salt lands in Sind and in the Deccan. No. 2 deals with the disease that so greatly handicaps grape growing in the Deccan and which has entirely brought it to an end in some parts. No. 3 is the first instalment of a systematic study of the seed sown in this Presidency. Perhaps the most striking fact recorded in this connection is with reference to the large quantity of "hard seed" found in the case of some pulses. This hard seed, which may amount to 50 per cent., fails to germinate and so is wasted. The experiments with the Water-Finder recorded in No. 4 are very interesting, and it seems probable that this instrument will be of great value in the Deccan for detecting the presence of sub-soil water.

32. The leaflets all deal with simple matters in which we were prepared to make definite recommendations. No. 13 is perhaps somewhat remote from our province, but in view of the trouble that is caused to cultivators by guinea-worm in many parts it was thought that it would be useful. It was prepared from information kindly supplied by the Sanitary Commissioner.

33. The Monthly Maráthi Journal "Shetki and Shetkari" already referred to came into existence at the close of the year and will fill a long felt want.

34. Mention must also be made of Mr. T. F. Main's "Wheat Survey", Mr. W. Burns' "Experiments on Wheat Rust" sent to the Inspector-General of Agriculture for publication as a memoir, and Mr. G. S. Henderson's "Note on the Rice Cultivation in the Lárkána District in Sind" published in the Agricultural Journal of India.

35. We get constant demands for vernacular literature on agricultural matters, and have hitherto not been able to supply it. With our gradually increasing supply of vernacular leaflets and with the Maráthi journal we are now in a somewhat better position. We must aim at getting out vernacular text books of agriculture suitable for different tracts, written in simple language and giving practical advice. Such an undertaking will involve much work, and we are not yet ready for it. Meantime every bit of recorded and published information is so much to the good.

36. Three Maráthi publications, privately published during the year, all deserve mention here and patronage by the public, *viz.*:—

(1) "Groundnut Cultivation in Konkan" by Mr. P. G. Joshi.
(2) "Cultivation of Fruit Trees" by Messrs. G. B. Patwardhan and B. S. Kolhatkar.
(3) "Diseases of Cattle" by Mr. D. B. Bápat.

CHAPTER V.

AGRICULTURAL ENGINEERING.

Well boring in Gujarát.

37. During the past year boring was continued in Gujarát with the Cawnpore tools, and an additional set was purchased; so that there were five sets at work instead of four as in the previous year. The *modus operandi* was explained in last year's report, and there has been no change in this respect. As regards organisation we arranged with well owners that they should provide the labour in all cases, and when water was struck they should agree in addition to pay for the cost of the piping and the wages of the mukádam. In cases where water was not struck we were to be at liberty to remove the piping sunk in the well and were to pay the wages of the mukádam in charge. On all occasions we provided the tools and the supervision free of charge. In the case of the Ahmedabad District where we were doubtful about success we agreed to pay the cost of the labour in cases where no water was struck.

38. The results of the year's operations were as follows:—

55 wells were bored, of which 31 borings were successful, 22 unsuccessfull and 2 unfinished. The record would have been better but for the excursion into the Ahmedabad District. In that district 8 wells were bored, of which 7 proved unsuccessful; and we now know that in the Viramgám and Dholka tálukas the water is too deep for our tools to reach at a remunerative rate. In the case of the 8th well which was in the Daskroi táluka the result was very successful. In the neighbourhood of Dákor in the Thásra táluka of Kaira District rock was struck after boring had been carried to a considerable depth; and the work had to be abandoned. The tract to the south-east of Nadiád also was found to be unfavourable, and six failures occurred here. The overseer was ill-advised to continue operations in this locality, where the experience of last year had given small prospect of success. In the Borsad táluka, on the other hand, boring gave satisfactory results; in the Umetha State the six borings made were all successful, and in the Surat District the six wells bored were all successful. The experience of this year adds to our knowledge of the subsoil water, and the information gained has been carefully recorded.

39. Financially the results may be summed up as follows:—

The 31 successful borings have given an additional water-supply equal to the water sufficient for 63 kos to work. The total cost amounted to Rs. 7,785 which works out at an average cost of Rs. 125 for water sufficient for a kos. The charges were roughly divided as follows:—

	Rs.
The well owners paid for labour charges and piping	4,200
Government paid for supervision, tools, repairs and management ...	3,585

40. The advantage obtained does not quite end with the additional water gained; for in several cases the quality of the water was improved and the level considerably raised; while in some instances where the water-supply was improved to an extent which made it sufficient for 5 or 6 kos the well owner is able to use an oil engine to lift the water. This has been done by a few men; and there is no doubt that where the well owner is a careful and intelligent man and will take trouble with his engine he can lift his water far more economically in this way than by means of bullocks.

41. I would again express commendation of the work done by Mr. Nagindás, the overseer in charge.

Oil-engines, Pumps and Cane-crushers.

42. In last year's report an account was given of the engines that we had purchased and the tests which we proposed to make; and I had hoped to be able to report this year some results of these tests. There is no doubt, however, we had gone too fast without adequate expert advice. At the end of November 1909 the services of Mr. A. A. Musto of the Public Works Department were lent to this Department for work in this connection. He found that most of

our engines were very badly fixed and that some of them had been seriously injured. They were running so badly that it was useless to make any tests, and a considerable part of his time was taken up re-setting them. In addition to this he advised a large number of persons who consulted him on matters connected with agricultural engineering. Most of these enquiries related to machinery for driving pumps, crushers, ploughs, etc., and some related to well boring and blasting. In some cases it was necessary for him to visit the enquirer's land before advising, in other cases no visit was necessary. In several cases he arranged for the repairs of machinery belonging to cultivators and in a few cases he put up machinery for them.

43. After inspecting many small engines used for pumping water etc., he is of opinion that the great stumbling block in the way of agricultural machinery will be that people do not appreciate the necessity of having their machines carefully set, and repaired only by a skilled mechanic; that skilled mechanics are difficult to get in the mofussil, and that the ordinary driver is careless and inefficient. He has now got together the necessary tools and staff; and after another year's experience will be able to arrive at more definite conclusions.

44. Success had been claimed in the Bijápur District for gelignite as opposed to black powder for blasting wells, and enquiries had been received on the subject. In order to test the somewhat unintelligible results reported from that district, the Agricultural Engineer made a test to compare the efficiency of the two, and found that except for work in water black powder was the cheapest.

45. A large suction-gas pumping plant has been purchased for trial at Nandgaum (Poona District) on the bank of the Bhima river. The Agricultural Engineer has drawn up the plans for fixing it and for arranging the pump so as to deal with the difficulty caused by the wide difference between high and low water level. The project has been sanctioned by Government and the work will now be taken up.

CHAPTER VI.

Agricultural Associations.

46. The following additional Agricultural Associations have come into existence during the past year :—

1. The Deccan Agricultural Association, Poona.
2. The Táluka Agricultural Association at Jalgaon (East Khándesh).
3. The Agricultural Association at Amalner (East Khándesh).
4. The Kusumba and Dhulia Táluka Agricultural Association at Kusumba (Táluka Dhulia, West Khándesh).
5. The Nevása Agricultural Association at Nevása (Ahmednagar District).
6. The Válva Táluka Agricultural Association at Islámpur (Sátára District).
7. The Muddebihál Agricultural Association at Muddebihál (Bijápur District).
8. The Agricultural Association at Umbargaon (Thána District).
9. The Murbád Táluka Agricultural Association (Thána District).
10. The Agricultural Association at Honávar (Kánara District).
11. Krishikarmottejak Mandali at Holialur (Ron Táluka, Dhárwár District).
12. The Shetki Sangh of Sampgaon (Belgaum District).

47. This gives us a total of 31 Agricultural Associations now in existence. The Deccan Agricultural Association, which was formed during the past year, has an influential membership and has received considerable sums in the form of subscriptions. It is designed to be a central Association forming a link with the other Associations in the Deccan. During the first year of its existence it has held several general meetings at which papers on agricultural subjects were read and a discussion followed and in September 1910 it invited the members of all other Agricultural Associations to a conference and a

demonstration at Poona. This was successfully held at the Agricultural College. Sub-committees appointed for various purposes have visited villages near Poona, and interested cultivators in several lines of improvement, and arranged for the provision of some good types of seed. Its most important achievement, however, has been the starting of the Maráthi Agricultural Journal "Shetki ani Shetkari" already referred to.

48. As mentioned in Chapter III several of the Associations were responsible for the organisation of agricultural shows: and in many cases the members took great personal interest in the work and devoted much time and trouble to make the show a success. For this our best thanks are due to them. Several Associations encouraged the sale of iron ploughs and acted as agents for their distribution; a very useful form of work. It must be confessed, however, that in most cases the efforts made have been by individuals rather than by any Association as a whole, and it is not easy to get any Association to undertake continuous or independent work. It is something, however, if they serve to create and keep alive an interest in agricultural improvement, and give this Department their countenance and assistance in the work that we are undertaking. This they are doing; and it is possible that more independent work will be taken up by them hereafter.

CHAPTER VII.

General.

49. It has been impossible in this report to touch upon all the matters at which we are working. It will be realised that a great part of the time of the Department is occupied with educational work. At the College two courses are now in progress, *viz.*, the University course and the short course. The first Agricultural vernacular (Maráthi) school has come into existence and will be soon followed, I hope, by a Kánarese and a Gujaráti school. We propose this year to give some short courses of definite instruction on our farms. Proposals have been sanctioned for the creation of an Agricultural School at Mirpurkhás in Sind to give a course of practical instruction in agriculture, as soon as funds and staff admit of this work being taken in hand. It will be realised from this that the prospects of educational work developing in this Department are great.

50. The work of the Agricultural Chemist and the Economic Botanist is being vigorously pushed on and in each case is likely to lead to valuable results. As regards Mycology and Entomology the various Departmental reports will be found to contain many references to the damage caused by insects and fungoid diseases. It is, however, of little use to deal with such matters in an annual report. The only satisfactory way to deal with work done in these matters is in a special bulletin or memoir devoted to the subject. Such bulletins will be published as soon as the knowledge gained on any subject admits of it.

51. In conclusion I have again to acknowledge the very hard and willing work by the officers of this Department. The Divisional Inspectors are opening up new and valuable lines of work, and in Sind Mr. Gul Mahomad is continuing with energy the campaign in favour of better cultivation and proper rotations. The members of the staff on the farms and in the districts have for the most part worked keenly and well.

I have the honour to be,
Sir,
Your most obedient servant,
G. F. KEATINGE,
Director of Agriculture.

No. 1687 of 1910-11.

Poona Agricultural College;
Poona, August 17th, 1910.

From

HAROLD H. MANN, D.Sc.,
Principal, Poona Agricultural College;

To

The DIRECTOR of AGRICULTURE, BOMBAY,
Poona.

Sir,

I have the honour to submit, herewith, the report of the Poona Agricultural College for the year ending June 30th, 1910, in accordance with Government Resolution No. 12036 (R. D.), dated December 13th, 1909.

College Buildings.

2. The year under report is the second since the establishment of the College as a separate institution. At the commencement of the year the work had just been transferred from the temporary quarters it had occupied at Kirkee to that portion of the new buildings which is ultimately to form the chemistry and physics block of the completed college. This made an immense improvement in the satisfactory carrying out of the college work. Although the college was still somewhat cramped in certain directions, yet the convenience for those most important was immensely increased. On May 1st, 1910, a further portion of the new buildings was occupied, namely, the west wing of the main college building, to be used for botany, seed-testing and miscellaneous work. This has again improved the conditions under which the work is carried on, and we can now wait with some patience the somewhat tardy completion of the main block of the college buildings. These, it is anticipated, will not be occupied at least until May 1911.

University Agricultural Course.

3. In my last report, I referred to the unsatisfactory nature of the Agricultural course established by the Bombay University in 1907, and which was almost unworkable. As a result of representations made by the University examiners in 1909, the Syndicate appointed a committee, consisting of Dr. Mackichan, Rev. F. Dreckmann, Prof. J. B. Knight and myself, to suggest modifications in the syllabus, which finally reported in favour of very considerable changes being made. With very slight modifications effect was given to this committee's report by the Senate in November 1909. The new course has already proved itself a great improvement, and I do not think any further serious changes will be required for a number of years.

Short Course.

4. At the end of my last report I referred to a new departure which had just then been made. In addition to the University course, which is the main business of the College, it was decided to establish a short one year's course for farmers' and landowners' sons, who knew English, and who wished to have

a practical agricultural training. It was to be essentially practical and to give the men as good an acquaintance as possible with the best methods of agriculture applicable to our areas, without a large amount of theory. This course, which was considered as an experimental one in the first year, was attended by four students. Two of these were very satisfactory, but the other two were not so, and it seemed doubtful whether the course met a real need. It was, however, decided to continue it for a second year with a new lot of students, and this opened in June 1910. I am glad to say that the attendance and the character of the students at once dissipated any doubt on the subject. Twelve students have joined, all landowners and all with the fullest intention of farming their own lands, and all have entered enthusiastically into the work. The staff of the College carry on this course in addition to their other duties.

College Staff.

5. The staff of the College at the beginning of the year under report was as follows, with dates of appointment to the College :—

Principal and Professor of Chemistry—Harold H. Mann, D.Sc., (1907).

Professor of Agriculture—Jewell B. Knight, M.Sc. (1904).

Professor of Botany—William Burns, B.Sc. (1908).

Assistant Professor of Agriculture—G. K. Kelkar (1907).

Assistant Professor of Botany—H. M. Chibber, M.A. (1906).

Assistant Professor of Physics—H. K. Mehta, B.A., B.Sc. (1907).

Assistant Professor of Zoology and Entomology—R. M. Dixon, B.A. (1907).

Lecturer in Veterinary Science—D. D. Sanga, G.B.V.C. (1887).

Lecturer in Chemistry—D. L. Sahasrabuddhe, B.Sc., L.Ag. (1907).

Demonstrator in Agriculture—V. G. Gokhale, L.Ag. (1908).

Assistant Demonstrator in Agriculture—C. V. Sane, B.Ag. (1909).

Demonstrator in Veterinary Science—A. D. Lopez, G.B.V.C. (1909).

Demonstrator in Chemistry—N. V. Joshi, B.A., B.Sc., L.Ag. (1908).

6. During the term the following changes have taken place :—

(*a*) An Assistant Professorship of Mycology has been founded and placed under the general control of the Professor of Botany. Mr. S. L. Ajrekar, B.A. (Bombay and Cambridge), has been appointed to the position and seems likely to be a considerable acquisition to the staff of the College.

(*b*) Mr. G. D. Mehta, B.A. (Cambridge), L.Ag., on return from Europe, has been placed temporarily under the direction of the Principal to organise a seed-testing section at the college, and do teaching in Agriculture.

(*c*) Mr. N. V. Joshi, the Demonstrator in Chemistry, has been appointed first assistant to the Imperial Agricultural Bacteriologist at Pusa, Bengal, and, on leaving, his place was taken by Mr. N. V. Kanitkar, B.Ag.

(*d*) Mr. A. D. Lopez, Demonstrator in Veterinary Science, has also left the College on appointment to the charge of an important Veterinary dispensary at Násik. His position has been filled by Mr. F. Gracias, G.B.V.C.

Students.

7. The number of students shows a slight increase, when the above described short course is taken into consideration. The actual figure at the

end of the College year in the previous four years compared with that at present is shown in the following table :—

	1906.	1907.	1908.	1909.	1910 July 1910.
First year Students	36	26	31	38	36
Second year Students	40	38	39	26	33
Third year Students	13	31	34	39	27
Short Course Students	...	...	...	4	12
Special Students	...	...	...	1	2
Total ...	89	95	104	108	110

The students during the last three years included in the above table have come from the following parts of India :—

	1908.	1909.	1910.
Bombay Presidency { Deccan	31	34	32
Bombay Presidency { Southern Marátha Country and Konkan .	27	32	35
Bombay Presidency { Gujarát	22	17	18
Bombay Presidency { Sind	10	9	6
Eastern Bengal and Assam	7	10	8
Central Provinces	1	...	...
Bengal	2	2	2
Central India	2	1	...
Nizam's Dominions	2	2	4
South India and Ceylon	...	1	5

Arranged according to the castes or classes from which they come, the students stand as follows :—

	1908.	1909.	1910.
Bráhmins	67	68	64
Maráthas	3	4	5
Lingáyats	4	5	6
Pátidárs (Gujarát)	5	4	5
Mohammedans	7	7	7
Párs	1	1	2
Others	17	19	21

During the first two of these years (1906 and 1907) the College was a Department of the College of Science, Poona.

8. These students may be divided into three classes :—

(*a*) By far the larger number are qualified to study for, and intend to take, the agricultural degree of the Bombay University. The qualification on which the Bombay University insists, namely, the Previous Examination or its equivalent, is insisted on in the case of practically all students from the Bombay Presidency, and no student can, of course, appear for the University Agricultural Degree without it.

(*b*) The second class consists of a few students who are not admissible to the University Examination, but who are taking the regular course along with the first class of students. These exceptions arose from the fact that it has been decided by Government to allow scholars to be received *from Sind* who have only passed the Matriculation Examination, provided that they were to receive the same course and pass by the same standard as the University demanded. Under this ruling, one scholar

attended the College in 1908-09, one joined in 1909-10, and another has joined in 1910-11. At the same time some applications were received from other Governments in India to be allowed to send students and from private persons outside the Presidency for admission to the College—where the applicants were not fully qualified for the University course. Where there was evidence to show that such students could properly follow the courses, a small number has been admitted in 1908 and each succeeding year. The number so received has been as follows:—

	Admitted in 1908.	Admitted in 1909.	Admitted in 1910.
Bengal	1	...	...
Eastern Bengal and Assam	2	2	...
Nizam's Dominions	1	...	...
Sind	1	1	1
Bombay Presidency	...	...	2
Ceylon	...	...	2

Of course these students cannot take the University degree, but, if successful, they will receive the Diploma of the Agricultural College, and will be required to pass a test of equal difficulty to that imposed by the University.

(*c*) In the third place, we have the short course students already referred to. The places from which these come are as follows:—

Deccan	1
Southern Marátha Country	3
Gujarát	3
Nizam's Dominions	2
South India	3

As has been already stated, all these are the sons of landowners, and are taking the course for the sole purpose of putting their training to advantage on their own lands.

9. In addition to the above classes of students, we are being requested from time to time to take men for special subjects in which the College is particularly well equipped. Some of these are graduates who wish to come for some special study. Such, for instance, was one man, an M.A. of Bombay, who came for a short course in the practical study of fungi, more especially those which cause mildew in cloth. The Professor of Botany arranged a short course of practical work which exactly suited his needs. Others are students of other colleges who take, more especially, Botany and Zoology with us. Occasionally, further, we get a technical man who wishes to learn some special process of analysis. In all these cases, we consider it as part of our duty to try and fill any real need, where this can be done without interfering with ordinary college work.

University and other Examinations.

10. At the University Agricultural Examination held in 1910, the number of candidates shown in the following list were presented with results as indicated:—

	Sent up.	Passed.	Failed.	Percentage of passes.
First Examination in Agriculture ...	35	30	5	85·7
Second Examination in Agriculture ...	21	20	1	95·2
Bachelor of Agriculture Examination ...	39	36	3	92·3

Three candidates were placed in the first class in the First Examination: five in the first class in the Second Examination; while no student in the Bachelor of Agriculture Examination reached the standard required for first class.

A special college examination of the students not entitled to take the University Examination (referred to above) was held in February 1910, with the following result: —

	Presented.	First Class.	Second Class.	Failed.
First Examination in Agriculture	3	...	3	...
Second Examination in Agriculture	5	5	...	...

11. The number of scholarships offered by Government at this College has been changed twice during the past two years, though the principles on which they are given are the same. Candidates for scholarships are selected from those who have passed the Previous Examination by the Director of Agriculture, in consultation with the Principal of the College. The scholarships are given by preference to the sons of cultivators and each is awarded for the three years occupied by the course. During the years since their institution they have been awarded to students from the various districts as follows:—

	1907.	1908.	1909.	1910.
Deccan	3	2	...	2
Southern Marátha Country	2	2	3	3
Gujarát	3	2	2	3
Konkan	...	2	1	2
Total Number ...	8	8	6	10

Taken according to their castes and classes, they have been held as follows:—

	1907.	1908.	1909.	1910.
Lingáyats	2	2	2	1
Maráthas	2	...	1	...
Anávla Bráhmins (Gujarát)	1	...	2	...
Other Bráhmins	1	4	...	4
Pátidárs (Gujarát)	2	1	...	3
Jains	...	...	...	1
Others	...	1	1	1
Total Number ...	8	8	6	10

The total number of scholarships offered in 1907 and 1908 was eight, and all were tenable only by students who had passed the Previous Examination. In the latter year it was decided that more candidates, belonging to the actual cultivating classes, would probably be obtained, if four-year scholarships were offered to boys on passing the Matriculation Examination, one year to be spent at an Arts College (to enable them to pass the Previous Examination) and then three years at the Agricultural College as before. The number so offered and awarded in 1909 was six, but of the six, three only succeeded in qualifying for admission to the agricultural course at the end of their first year, the other three failing in the Previous Examination. The scholarships of the latter were, of course, withdrawn. One of those who passed also died shortly after, thus leaving only two out of the six to join this college in June 1910.

Nine similar scholarships have been offered to Matriculates belonging to the cultivating classes in 1910. These special scholarships were granted to different castes and classes as follows :—

Maráthás	4
Pátidárs	4
Koli	1

12. The scholars from Sind are on a different footing. They are appointed by the Commissioner in Sind, and are not required to have passed the Previous Examination in every case. We have now at the College two scholars from Sind in the final year, one in the second year, and one in the first year.

13. Other Governments and public bodies have utilised the College for the training of scholars. With the development of other Agricultural Colleges in India probably the demand for accommodation of such scholars from other parts of India will decrease. The number so admitted in each year since 1906 is as follows:—

	Date of Entry.				
	1906.	1907.	1908.	1909.	1910.
Government of Eastern Bengal and Assam .	...	3	1	2	...
Government of Bengal	...	...	1	...	...
His Highness the Nizam's Government ...	...	...	2	...	...
Government of Central Provinces ...	1	...	...	...	...
His Highness the Gaekwar of Baroda's Government	2	...	...	2	...
Sángli State	...	...	...	...	1
Lingáyet Education Fund	2	1	1	3	1
Marátha Education Association ...	...	1	...	...	...
Infanticide Fund, N. D.	...	...	1	...	...

Library.

14. The growth of the College library is exceedingly satisfactory. Three years ago it did not exist. On the separation from the College of Science being completed a number of books chiefly old and out of date, on Agriculture, Botany and Veterinary Science, were handed over to us and formed a nucleus for the future. A special grant of Rs. 6,000 per annum was made in 1909 for library purposes, and has been continued for the present year. With the funds thus made available, and a number of presentations of books, notably one of forty-four books from the Honourable Sir John Muir Mackenzie, the library has rapidly increased. A year ago the number of volumes was 1,182, now the number has reached 2,730, and it is becoming, what I should like it to be, the reference library in agriculture and associated subjects for the whole of Western India. It is freely consulted, not only by College students, but by gentlemen from all parts of the Presidency, and every effort is made to make it increasingly useful to the public interested in agriculture.

College Quarters.

15. The progress with regard to the provision of college quarters has not been satisfactory. At present we have old buildings accommodating twenty-eight students, and for the remainder we have to hire bungalows, and occupy temporarily some of the new quarters built for the use of servants situated on the College Farm. Our students are, in fact, now scattered over five different places, most of them a mile away from the College. By this means we are able to accommodate 90 students, but the arrangements are not by any means what I should like them to be.

The construction of the new college quarters near to the College has now been under discussion for two years and a half, and I consider the matter a very urgent one. I would be quite content if every other item of construction were delayed in order that these quarters might be pushed forward as soon as is possible. The matter of the provision of conveniently situated accommodation is specially important in the agricultural College. The students work longer hours than in any other college, and are often required to be present early in the morning for actual farm work, as well as during the regular college hours. To stay in the Poona City, or in quarters a long distance away, is, hence, particularly inconvenient and undesirable.

University Inspection.

16. During the year the College was visited by the University Committee of Inspection, who go round the various colleges in the Presidency once in three years. The following are extracts from their remarks on the College :—

"The College has hitherto been working under unfavourable conditions. It has had to crowd its classes, laboratories and museums in the smaller of the two blocks which are to become its ultimate home. The rooms in this block which have been equipped with a view to their permanent purpose are large, well lighted and the fittings are designed to secure ample space and facilities for work. The Chemical Laboratory is in all essential respects excellent, and taking into account the additional equipment that is approaching completion, it may be said that in respect of laboratories, museums and class-rooms the liberality of Government has made ample provision for the needs of the college.

"The present Library accommodation is small but the library is a growing and living institution. It contains already a good collection of the special literature that bears on the studies of the college, in all about 1,300 volumes and is largely used by the students.

"The teaching of the college includes a large amount of practical work which seems to be carried on according to sound methods, each student being encouraged to carry out modest researches of his own.

"The results of the recent examinations have not been quite satisfactory. This is due to the overweighted courses which are now being modified by the University and perhaps also to the fact that hitherto the college has not attracted to itself the best prepared material in its students. The best candidates in the Previous Examination generally find their way to the Arts and other colleges, the precise value of an agricultural curriculum being still somewhat indeterminate.

"Probably the staff is not sufficiently large for a college which aims at the varied training included in the agricultural course. The three superior professorships are held by three gentlemen, each of whom holds office under Government in Departments associated with his college work. In itself this is probably a wise arrangement in the interests of the college and of these Departments ; but it means that these gentlemen are not full-time professors and that the whole staff is smaller than it appears to be.

"We visited the present students' quarters which are situated at a long distance from the college. Ninety-five resident students are accommodatad in the bungalow formerly used as the college and in a set of rooms erected near this bungalow when the agricultural class was started. The students who reside in the bungalow are very comfortably housed; the old quarters are however not very attractive. The plinth of the building is very low and the rooms not specially cheerful. However as these are to be soon superseded by the fine quarters designed to be erected in the new college compound we need not remark further upon them . . . .

"On account of the additional work thrown on three of the professors, as above stated, by reason of their official duties it seems absolutely necessary to have three more specialists attached to the college. Otherwise it will be impossible for the professors to devote the time that is necessary to research work. However enthusiastic these workers may be at present, after a few years, as the demands of their over-time duties increase, the research work will be in danger of being neglected as we find to be the case at another Science College in which, when we made inquiry as to the research work carried on in the college, we were informed that there is scarcely any time left for it.

"In conclusion we would remark that we were struck by the excellent spirit which pervades the College. The Staff are enthusiastic in their work and this has awakened a healthy response on the part of the students. On this, which is after all a much greater thing than external equipment, the Agricultural College may well be congratulated."

Employment of Graduates.

17. With the increase in the number of graduates each year, the question as to how they are to be employed becomes a very serious one. Naturally, it is

to be hoped that a continually increasing number of students will leave the College with the intention of managing their own lands. I am glad to say that there is every sign of this being the case. At least seven men (including the short course students) who have left the College in the present year intend to make use of their knowledge on their own land. But there remains and must always remain in Bombay, a very large proportion of graduates who will be on the look out for other openings.

In the present year the following appointments have been made from the Bombay graduates of the Agricultural College :—

Government scholar in sugar refining	... 1
Imperial Agricultural Department	... 1
Central Provinces Agricultural Department	... 2
Eastern Bengal and Assam Agricultural Department ...	... 1
Baroda Agricultural Department	... 5
Bombay Agricultural Department	... 8
Bombay Revenue Service	... 5
Municipal and other bodies	... 2

As I remarked in my last report, it must never be forgotten, that under the conditions of the Bombay Presidency, where large land-owners are rare, it is probable that for a good many years to come, most of the students, whether they belong to the agricultural classes or not, will join the College and pass through the course primarily with the idea of putting their training to use either in the service of Government or of local public bodies. I think this is, in many ways, a good thing. It has long, I believe, been the declared policy of the Bombay Government to encourage the infusion of a certain number of men trained in agriculture into the ordinary revenue service, and, hence, it has been anticipated that there would be a considerable number of openings in this direction for agricultural graduates. I feel that the men who now graduate from the College are well worthy of such encouragement. They have had an intensely practical course; they have worked with their own hands on the land: many of them become, at any rate in the latter parts of their course, enthusiasts in the cause of agricultural improvement: and, judging by a number of the graduates whom I have had the chance of watching closely, many of them show a marked amount of originality. I think it would be good if, at any rate, during the early years of the College, marked preference could be shown for appointment to the revenue service to graduates in agriculture: after a few years they will be known, and will, I believe, be preferred on their own merits.

Veterinary Dispensary.

18. On August 1st, 1909, the District Veterinary Dispensary at Bhamburda was, under Government orders, taken over by the College to be run essentially as a College dispensary entirely under the control of the College authorities. Sufficient time has not yet elapsed to see the effect of this on the working of the dispensary, but I hope to report on this matter in detail next year.

Other Matters.

19. The staff have worked well and enthusiastically, and most of them are engaged in research in addition to their college duties. The students who come to the College nearly always dislike the course at first, and we lose a number each year within a month of the opening of the College. Afterwards, they gradually become reconciled to it and before their training is completed, they are usually very keen and enthusiastic. During the last year a professional and technical quarterly magazine has been started, under the control of a combined committee of staff and students, called the Poona Agricultural College Magazine, which has been very well received by the public, and is already paying its way. During the large Provincial Agricultural Conference held in Poona in September 1909, the senior students of the College, acted as volunteers and demonstrators and did so very successfully.

A great deal of outside interest has been manifested in the College during the year. It has been visited by a number of ruling chiefs, as well as by a large number of Indian noblemen and gentlemen. Cultivators from the surrounding districts are continually visiting the College and College Farm, both singly and in groups. During the year, the College has further become the head centre of the activity of the Deccan Agricultural Association, and the place from which its Maráthi Agricultural Magazine is published. Every effort is made to stimulate this public interest, as it is felt that the future and permanent success of the College must largely depend on the interest in the College taken both by the large land-owners and-small cultivators of the Bombay Presidency.

I have the honour to be,

Sir,

Your most obedient Servant,

HAROLD H. MANN,

Principal.

Review by the Director of Agriculture.

I have little to add to Dr. Mann's remarks.

2. The College is doing excellent work, and is progressing and developing satisfactorily. Mr. G. D. Mehta and Mr. S. L. Ajrekar are valuable additions to the College staff. The delay in commencing the construction of the students' hostel is very unfortunate.

3. It is certainly desirable that a large proportion of those who take their degree in Agriculture should leave the College with the intention of taking up agriculture as a profession; and there are two ways in which this tendency can be assisted. The first is by recruiting students of the class which owns land and has the desire and the tradition of cultivating. Such boys are to be found in the High Schools, and I hope that the system of hunting for them and offering them scholarships will in a short time give good results; but it must be admitted that our University course demands a degree of preliminary education which very few boys connected with the cultivating class are found to possess. The second way is to develop the study of the business side of farming, and impress on the imagination of the students the opportunities that are open to the man who can see them. The revised College syllabus indicates a departure in this direction which should be developed to its utmost. The knowledge of this nature which is gradually being acquired by the Department in various parts of the Presidency, will facilitate this movement; but we have much to learn before we can teach as we would wish.

4. The College is developing as a research institute and a centre for those requiring information connected with Agriculture. This will add to its living force, and, in so doing, will increase its educational capacity. I am confident that the Agricultural College will, under Dr. Mann's able guidance, increase in efficiency year by year both for education and for research.

G. F. KEATINGE,

Poona, 28th August 1910. Director of Agriculture.

THE VERNACULAR AGRICULTURAL SCHOOL.

The inception of the Vernacular Agricultural School at Poona was the result of a discussion which took place at the Agricultural Conference, which was held in Poona in September 1909. A great many opinions had been expressed in favour of teaching agriculture generally in village schools. The Director of Public Instruction expressed himself unfavourably to any such idea chiefly because the teachers who are likely to be available are not capable of teaching it at all satisfactorily. He, however, stated that he had no objection to special schools being started by the Agricultural Department for those who had passed through the village schools. Following this, Dr. Mann indicated that he was working out a scheme for submission to Government for vernacular agricultural instruction at the Poona Agricultural College. Finally, in their resolution No. 12036 (R. D.) of December 13th, 1909, Government expressed the opinion that while they would be glad to receive Dr. Mann's proposals they were "inclined to think that it would be even better if such schools or classes could be started away from the dry nursing influence of the College—say one in each Division, with an agricultural graduate in charge, who would work independently, subject of course to inspection and supervision by superior officers of the Department and of the College."

As a result of that, the proposals were modified, and, as submitted to Government, involved the creation of one vernacular agricultural boarding school at Poona, as an experiment. It was suggested that the course should be one of two years, that it should be open by preference to boys between the ages of 13 and 16 who had passed the Maráthi fourth standard, and that it should be quite independent of the Agricultural College, but should at the same time utilise a definite part of the College farm for practical work. In this form the scheme was approved by Government, who decided to make the course entirely free at present, and a grant of Rs. 5,000 was made in the current year for the purpose.

The school on this basis was opened on June 10th, 1910, under the charge of Mr. K. M. Pawár, B.Ag., a Maratha agricultural graduate and a cultivator by birth and training, with an assistant teacher detailed from the Educational Department for the purpose. A large number of applications for admission were received from all the Deccan Maráthi-speaking districts. Some of these were unsuitable; but twenty-one were selected, all of whom were village boys, many of them being the sons of substantial cultivating pátils, and all the sons of owners of land, to be worked in future by these boys. It was specifically stated in the prospectus that under no conditions would the school give any qualifications for Government service.

The twenty-one boys now in the school are derived from the various Deccan districts as follows:—

Poona	...	...	5 boys.
Sátára	...	...	2 „
Sholápur	...	...	1 boy.
Ahmednagar	...	...	2 boys.
Násik	...	...	7 „
Khándesh	...	...	1 boy.
Ratnágiri	...	...	1 „
Kolhápur State	...	...	1 „
Nizám's Dominions	...	...	1 „

Of these nine are Maráthas by caste, one is a Máli; there are eight Bráhmins (several being the sons of Bráhmin village pátils from Násik), and three others belong to minor village castes. Their ages vary from 13 to 18. All have passed the Maráthi fourth and some the Maráthi seventh standard.

The scheme has been supported by several Local Boards. The District Local Board of East Khándesh has made a contribution of Rs. 200 to the school for the present year, while that of Poona has agreed to contribute Rs. 5 per month for each boy from the Poona District in the school.

The curriculum at present is experimental, but the essential part of it is the field work. The boys spend half their time in the field, and actually work

the land attached to the school with their own hands. Out of thirty-two hours' school work per week, sixteen are spent in the field, in gardening, and in similar work. The object is to give the boys a knowledge of the best methods which we know are applicable to their own conditions. The school work more properly so-called, consists of Arithmetic, more especially including farm accounts on the one hand, and Mensuration applied to agricultural purposes on the other; Nature Study largely taught practically; Writing and Reading; Geography more especially in relation to crops; the Principles of Agriculture, and two new subjects, (1) Village Life, including sanitation, hygiene, and secondary occupations suitable for villages, and (2) what we call 'Citizenship' which includes questions of how to obtain money by takávi, or co-operative credit, and in addition the system of local and village Government in this part of India.

So far the school is progressing well; of course, it is impossible until it has been going longer to express a definite opinion with regard to its success. There is no doubt, however, as to its popularity, and the calls are loud and insistent for simliar schools in other parts of the Presidency. Mr. Pawár, as head master, has thrown himself into the work with great enthusiasm.

APPENDIX I.

Summary of Experimental Work under the Deputy Director of Agriculture, 1909-10.

Cotton.

1. At Dhárwár the most important work in cotton is in connection with the introduction of the Navsári (Broach) variety from Gujarát. The season under report was favourable to cotton and the Navsári crop did very well yielding up to 789 lbs. of seed cotton per acre in the case of newly introduced seed and at the rate of 650 lbs. per acre in the case of seed introduced six years ago. The best yield of local Kumpta cotton on the Farm was at the rate of 620 lbs. per acre. The ginning percentage of the newly introduced Navsári cotton was 32·28 per cent., whilst that of farm grown Kumpta averaged 26·9 per cent.—a high figure for Kumpta. It may further be mentioned that 200 out of 600 nagás (1,344 lbs. of seed cotton) of Navsári (Broach) cotton produced by cultivators ginned at 33 per cent. or above, while a sample of cultivator's Kumpta ginned at 26·2 per cent. With regard to the quality of the lint of Navsári (Broach) cotton grown at Dhárwár it would appear that this falls off a little in the first season and approximates to the quality of the cotton produced near Broach, but this tendency does not increase in subsequent years, for a sample of this cotton grown from seed introduced six years ago was valued at about the same figure as a sample produced from the newly introduced seed. This Navsári (Broach) cotton has two special advantages over the local Kumpta cotton, *viz.* (1) its considerably higher ginning percentage, and (2) its superior colour. The chief disadvantage about this cotton is its longer period of growth which is 8 months against the six required by Kumpta which necessitates the sowing of Navsári at the very commencement of the rains and gives this variety the reputation of being a more exhausting crop than Kumpta. This necessity for early sowing limits the area suitable for Navsári cotton in the Karnátak owing to the early rains not being prevalent at all places otherwise suitable, while in a season when the anti-monsoon showers are deficient thus delaying preparatory tillage or when the proper monsoon sets in late, the area sown with this crop will be contracted because this cotton should if possible be sown before the middle of July and certainly not later than the end of that month.

2. Careful plant to plant selection for quality and ginning percentage is being carried on with local Kumpta and also with several of the more promising hybrid cottons at Dhárwár, while several new hybrids have been secured; these have been made with one or other of the objects of improving the quality of the fibre, increasing the ginning percentage or adding to the vigour of the variety.

3. Analytical work has shown that the cottons of the Karnátak are cultivated in a very mixed condition. There are two commonly cultivated varieties, *viz.* Kumpta and Dhárwár-American, specifically distinct from one another and requiring different agricultural conditions. Nevertheless it has been found that the Dhárwár-American variety is hopelessly mixed with Kumpta, while Kumpta, though largely mixed with Dhárwár-American, is not nearly so commonly grown in this adulterated condition as Dhárwár-American is. It appears that there is a common practice at the Hubli gins to mix 5, 10 and even 20 per cent. of Dhárwár-American with inferior classes of Kumpta with the object of improving the colour of the latter. The cultivators who depend very largely upon the gins for providing their seed, thus get an adulterated article and hence the admixture in the field.

4. At Gadag the experiments with cotton are confined to Dhárwár-American cotton and newly introduced Americans and similar cottons such as Cambodia and hybrids of these varieties. Of the American varieties under trial New Orleans appears to be one of the most promising. It gave a yield of 587 lbs. of seed cotton per acre against the 384 lbs. of the local cotton and ginned at 32·5 per cent., but several other varieties have given better ginning percentages. Boyd's Prolific, Allen's Hybrid and Allen's Long Staple have ginned respectively at 38·2, 37·2, and 36·8 per cent. The strongest point however in these cottons is the quality of their fibre. Texas Long Staple has been particularly well valued, while New Orleans, Allen's Hybrid and Allen's Long Staple are highly reported upon. Full details of these valuations may be found in the Dhárwár Annual Report for 1909-10. Selection and hybridization are also being practised upon local Dhárwár-American cotton and some of the promising exotics.

5. Cambodia cotton was grown at several places during the year under report. There are several varieties, derived from different sources, which are scarcely distinguishable, but a variety obtained from Madras (102 E) has again given the best results at Dhárwár as was the case last year. It has yielded at the rate of 491 lbs. of seed cotton per acre and given the high ginning percentage of 39 per cent.

At Gadag these cottons were grown on a large scale. Here again Madras Cambodia (102 E) has done best with a yield of 430 lbs. of seed cotton per acre and a ginning percentage of 42·8 per cent. against the local Dhárwár-American which yielded at the rate of 384 lbs. per acre and ginned at 30·7 per cent. The valuations of these cottons show that the lint is worth about the same as that of Dhárwár-American, but there is one adverse quality about the fibre which appears to be weaker (at least in the season under report) than that of Dhárwár-American and it will therefore be necessary to select very carefully for strength.

6. At Surat the special work in cotton has been chiefly confined to selection both among the more promising hybrids and in the pure local variety but a few additional hybrids have been secured and the best Surat cottons have again been grown on a piece of land in the Eru village near Navsári. A number of samples of these cottons were sent to the Bombay Cotton Trade Association and to the Imperial Cotton Specialist for valuation. Both this year's selected samples as well as average unselected samples were valued. The valuations of the Bombay Cotton Trade Association and those of the firm who valued for the Imperial Cotton Specialist vary a good deal. For the sake of convenience these valuations have been reduced to a percentage basis and are tabulated below in statements I and II. The figures however are not strictly comparable as these cottons were not all grown under identical conditions. It will be observed that the effect of growing these cottons at Navsári is very beneficial.

STATEMENT I.

Surat grown Cottons.

Register number.	Sample from selected plants in 1909-10.		Sample from general picking (*i. e.* without selection) in 1909-10.	
	By the Cotton Trade Association.	Through the Imperial Cotton Specialist.	By the Cotton Trade Association.	Through the Imperial Cotton Specialist.
Hybrid 1027-A. L. & F. (2nd picking 1907-08)	106	112	103	101·5
Hybrid 1018-P/G	104·5	104·5	103	103
Hybrid 1340 L. & F.	104	110·5	101·5	107·5
Selection (1904) of Surat-Broach (1st picking 1907-08)	101·5	104·5	100	101·5
Ordinary farm grown Surat-Broach ...	...	...	100	100

STATEMENT II.

Navsári (Eru) grown Cottons.

Register number.	Sample from general picking (*i. e.* without selection) in 1909-10.	
	By the Cotton Trade Association.	Through the Imperial Cotton Specialist.
Hybrid 1027-A. L. & F. (2nd picking 1907-08)	106	110·5
Hybrid 1018 P/G	104·5	104·5
Hybrid 1340 L. & F.	100	109
Selection 1904 of Surat-Broach (1st picking 1907-08)	104	103
Ordinary Navsári cotton grown from seed obtained from the village Bhutsad	100	100

7. A few samples of these cottons were sent to the Bombay Mill Owners' Association in order to ascertain their relative spinning counts. The ordinary Surat variety was reported to be good for spinning 16*s*. to 20*s*. Selection (1904) of Surat-Broach II was said to be rather coarse but good for spinning 20*s*. Hybrid 1018 P/G was considered a little superior in feel to the last mentioned and reported to be good for spinning 24*s*., while hybrid 1027A Long and Fine was described as creamy-white and good for spinning 30*s*. to 32*s*. The above were grown on the Surat Farm but samples of the same cottons grown at Navsári (Eru) were also reported upon. The local Navsári variety was considered good for spinning 30*s*. Selection (1904) Surat-Broach II was described as white, soft feel, and good for spinning 32*s*. to 36*s*. Hybrid 1018 P/G was reported to be white and soft and good for spinning 36*s*., while hybrid 1027A Long and Fine was considered inferior to selection (1904) Surat-Broach II both in colour and staple and reported to be good for spinning up to 24*s*.

8. Seed of a few of these cottons was distributed among cultivators who sowed about 280 acres in the year under report. The crop from this seed was generally superior to that grown from the ordinary Surat stock. Special arrangements were made with the Manager of Messrs. Gulam Baba Mills in Surat to purchase the seed cotton produced by cultivators from Farm distributed seed and these cultivators thus secured Rs. 7 per Bhár (of 924 lbs. seed cotton) or 5 per cent. more for their cotton when local Surat cotton was selling for

Rs. 135 per Bhár. The yield obtained from Farm distributed seed was also estimated to be considerably higher than that of the ordinary crop; in some cases it was 100 lbs. per acre heavier, which in the past season was worth Rs. 17. If therefore we take the outturn at 500 lbs. of seed cotton per acre the cultivator would benefit to the extent of (Rs. 17 for increased yield + Rs. 4 for improved quality) Rs. 21 per acre.

Moreover another advantage attached to this Farm seed was noticed by the cultivators, *viz.*, the uniformity with which the bolls opened, thus enabling a considerable saving both in picking and watching to be effected.

9. At Dhulia the work of separating out the different types which constitute Khándesh mixture was in progress. Comparative trials of the several types resulted in the white flowered types proving superior both in point of yield and ginning percentage to the yellow flowered types. The yield of the white flowered narrow lobed type yielded at the rate of 870 lbs. of seed cotton per acre and gave a ginning percentage of 37·50 whilst the yields of the various yellow flowered types ranged from 685 lbs. to 741 lbs. of seed cotton per acre and their ginning percentages varied from 26·10 to 30·00 per cent. A few samples were valued by the Bombay Cotton Trade Association. A sample of the white flowered type was reported to be worth Rs. 290 per khandi of 784 lbs. and a sample of a yellow flowered type was reported to be worth Rs. 305 per khandi. It will therefore be seen that although the quality of the fibre of the white flowered types is a little inferior to that of the yellow flowered types still the great superiority in ginning percentage and yield of the former renders it the more profitable cotton for the cultivator to grow.

10. Among new varieties of cotton tried at Dhulia, Comilla and Cambodia varieties have done fairly well. The former gave the exceptional ginning percentage of 45·45 per cent, while Cambodia yielded at the rate of 624 lbs. of seed cotton per acre and gave a ginning percentage of 34·80. Buri cotton was also tried; its yield was 655 lbs. and its ginning percentage 31·50. Among the several hybrid cottons a cross between Comilla and Bani promises well, having produced a plant combining improved quality of fibre with high ginning percentage. This is a new cross and it is too early yet to say whether these characters will be maintained but very careful selection is being made with that object in view.

11. At Nadiád Bourbon tree cotton 10 T in its second year yielded at the rate of 564 lbs. and left a net profit of Rs. 62-10-8 against a yield of 568 lbs. of seed cotton per acre in its first season last year.

The two hybrid cottons 1367 and 1368 which are crosses between the annual variety Texas of America and the perennial Bourbon have shown annual tendencies and did not do well when kept for a second season. Crops raised from fresh seed sown in May have done fairly well giving outturns of 536 and 652 lbs. of seed cotton per acre valued at Rs. 375 per candy (of 784 lbs. cotton) when fine machine ginned Navsári-Broach was priced at Rs. 360. The cost of production was Rs. 49-9-9 and the value of the produce about Rs. 80 per acre.

12. At Dohad Khándesh cotton again did very well in the year under report yielding at the rate of 1,070 lbs. of seed cotton on an area of one-fifth of an acre and at the rate of 795 lbs on another plot of three-fourths of an acre and left a net profit of about Rs. 40 per acre. This cotton has a special value for Dohad because it matures before Christmas and is therefore not likely to be damaged by frost which may occur towards the end of December. In point of quality however this cotton produced at Dohad is inferior to that grown in Khándesh.

13. *Mendelian Investigations.*—Experiments are in progress at Dhárwár and Surat upon cotton. At Dhárwár several of the crosses have reached the second generation. In order to prevent the possibility of natural cross fertilization the buds on each plant are protected until the bolls have set. At Dhárwár in a cross between white flowered obtusifolium (female) and yellow flowered obtusifolium (male) all the plants in the F_1 generation last year were yellow flowered, while in the F_2 generation out of a total number of 485 plants 366 were yellow flowered and 118 white flowered thus giving a proportion of 3·02 : 1 or almost the theoretical proportion of 3 : 1. At Surat crosses between white and yellow flowered neglectum cottons have reached the F_3 generation and are apparently conforming to the Mendelian law. In the F_1 generation all the plants were yellow flowered. In the F_2 generation some of the offspring were yellow flowered and some white flowered, while in this the F_3 generation the white flowered plants of last year have given rise to only white flowered offspring. Some of the yellow flowered plants of the F_2 generation have produced only yellow flowered offspring while others have split up and produced both yellow and white flowered offspring. Although the total number of plants dealt with was small, nevertheless the proportions of yellow and white flowered plants were approximately those theoretically expected.

Crosses made between red flowered Arboreum (male) and yellow flowered Kumpta (female) and *vice versâ* have also given fairly approximate proportions in this the F_2 generation, but in these crosses a few complications have arisen owing to the occurrence of pink and white flowered plants which are more fully discussed in the Dhárwár and Surat Station Annual Reports.

Crosses between tree cottons in which one parent was chain seeded and the other free seeded have reached the first generation in which all the offspring without exception are free-seeded, thus indicating that this character is dominant over that of chain seeded.

Wheat.

14. The brown soils found in the Panch Mahâls are well suited to wheat cultivation and some very good results have been obtained at Dohad in the season under report. There are several local varieties representative both of Macaroni and bread wheats. A few of the best Macaroni wheats including Shet Párner and Bansi were given a trial. These yielded at the rates of 1,634 lbs. and 1,377 lbs. of grain per acre, respectively, and left net profits amounting to Rs. 76 per acre in the case of Shet Parner and Rs. 62 in the case of Bansi. These wheats were sent to Messrs. Ralli Brothers of Bombay for valuation who reported Shet Párner to be worth about Rs. 6-5-6 per cwt. and Bansi Rs. 6-0-0 per cwt., while they valued the local variety of Dhola Kátha at Rs. 5-6-0 per cwt.

There is one important difficulty in growing hard wheats at Dohad in seasons of heavy rainfall or where irrigation water is given, *viz.*, the tendency for the occurrence of spotted grains. Work is now in progress to ascertain how far the occurrence of such grains can be controlled. Similarly there is a tendency for the colour of the grain to change and efforts are being made to get a more uniform sample in this respect also. Among the soft wheats under trial at Dohad Hybrid of Nágpur into Muzaffarnagar produced a very fine sample of grain valued at Rs. 5-5-0 per cwt., Daudkhani of Delhi, Australian No. 27 and Muzaffarnagar produced grain valued from Rs. 5-3-0 to Rs. 5-1-0 per cwt., while the local Wagia variety was valued at Rs. 4-10-0 per cwt. The best yielders proved to be Daudkhani of Delhi with 2,044 lbs. of grain per acre which left a nett profit of Rs. 86-7-9 per acre and hybrid of Nagpur × Muzaffarnagar which yielded at the rate of 1,446 lbs. of grain per acre giving a nett profit of Rs. 65 per acre.

15. At Nadiád several wheats were under trial but rust did a great deal of damage and considerably reduced the yields and this is probably the reason why the inferior Khapli (a spelt wheat) wheat is so commonly grown in the Kaira district as this wheat is practically immune to attack from rust. Shet Párner wheat was one of the least affected and was well valued at Rs. 6-6-6 per cwt. by Messrs. Ralli Brothers of Bombay.

16. At Dhulia experiments indicate that Mundi the common irrigated variety could advantageously be replaced by Bansi because the latter gives about the same outturn while in point of price Messrs. Ralli Brothers valued Bansi at Rs. 6 3-0 per cwt. against Rs. 4-14-0 for Mundi. The only risk of growing Bansi as an irrigated crop is the tendency for the sample to contain a number of spotted (softish) grains which naturally reduce its value. Shet Párner wheat grown at Dhulia does not appear to be superior to Bansi.

17. In the Karnátak there is only one commonly cultivated dry crop wheat, *viz.*, hard red local, which is a Macaroni wheat. Two superior Macaroni wheats Bansi and Shet Párner from Khándesh and the Deccan, respectively, were compared with this local variety and proved to be very superior in point of quality, being valued by Messrs. Ralli Brothers of Bombay at Rs. 1-8-0 and Rs. 2 per cwt. higher than the local variety, which they valued at Rs. 4 8-6 per cwt. The local merchants in the Dhárwár Bazár also valued these wheats at 2 to 3 lbs. per rupee better than the local variety, which they valued at 22 lbs. per rupee. The growing period for wheat at Dhárwár however is very short and in the season under report it was particularly so, amounting to only 12 weeks for the local variety, while Bansi took 15 weeks and Shet Párner 14½ weeks. The yields of these wheats are however rather low but it may be possible by means of selection to evolve early maturing strains which will yield well. As the average period of growth of the local wheat is only about 3½ months, any new variety to be successful in the Karnátak must be an early maturing variety.

At Gadag Shet Párner wheat also did well but it took longer to come to maturity than the local, which is similar to the local wheat of Dhárwár.

18. *Selection.*—At Dohad, Nadiád, Dhulia and Dhárwár selection is being carefully carried on. The first object aimed at is to purify those varieties which are commonly grown by cultivators in a mixed condition. Special attention is being given to the question of improving the outturn of Bombay wheats by selecting for longer ear-heads, better tillering and greater resistance to rust disease. Except in the northern parts of the Presidency all the Bombay wheats belong to the Macaroni class and the improvement of quality is of comparatively less importance than that of yield.

Jowár.

19. At Dhárwár the Sadgar variety did best last year and again promised to take first place in the season under report but it suffered severely from a fungus disease locally known as Chikta, and although its yields of kirbi exceeded that of all other varieties still this disease reduced its grain yield very considerably. Chapti jowár from Gujarát did better this year although in its early stages its growth was lacking in vigour; it however improved later on and ultimately yielded higher than the local varieties with an outturn of 1,500 lbs. of grain per acre.

20. At Dhulia it is necessary that for jowár to be a successful crop the variety must be an early maturing one. Owing however to the peculiar distribution of the rains in the year under report a comparatively late variety (Mothi) did better than the early variety Gudgi. This was brought about by a long break in the rains during which time the early variety ripened off and could not take advantage of the subsequent good rains which greatly benefited the Mothi variety. Fulgar yellow jowár from Dhárwár was tried at Dhulia but owing to the yellow colour of its grains there is no local market for its produce, which demands a light coloured grain. This variety has therefore been rejected.

21. At Dhárwár in the year under report three of the best fodder varieties of jowár were compared with the local variety of Fulgar yellow which is a grain variety in addition to yielding superior kirbi. The varieties were cut when still green at the flowering stage. The Utávali variety gave an outturn of 18,048 lbs. of green fodder against 22,876 lbs. of Fulgar yellow, while Nilva and Sundhia variety yielded at less than half the above rates; but this may perhaps be accounted for by lack of acclimitization.

22. Careful selection in local jowárs is now being carried on at Dhárwár, Gadag and Surat with the object of improving the size of grain, increasing the outturn per acre and securing uniformity in the crop.

Groundnuts.

23. At Surat Spanish peanut has again provided the most suitable variety for dry-crop cultivation on heavy black cotton soil in Gujarát. The season under report was not a very favourable one for groundnuts, but this variety yielded at the rate of 1,693 lbs. of nuts per acre, and left a net profit of Rs. 63-6-10 per acre. During the past 4 years the average yield of Spanish nuts has been 1,039 lbs. of nuts worth Rs. 78-14-4, while the average cost of production has been Rs. 51-4-9 per acre.

24. At Dhárwár the rainfall is better distributed than at Surat and the soil also is lighter and hence the conditions are more favourable for groundnut cultivation. Several varieties were grown as dry-crops and the results obtained show that the most suitable varieties in a favourable season will yield from 2,200 to nearly 2,900 lbs. of nuts per acre. The highest yielder in the year under report was Tamboo variety with an outturn of 2,888 lbs. per acre; but both Mozambique and Senegal varieties exceeded 2,800 lbs. per acre. These varieties have left a net profit of Rs. 30 per acre in spite of the extremely heavy charges of cultivation which amounted to nearly Rs. 72 per acre owing to the costly work of harvesting the crop. The kernels of Senegal contained 51·12 per cent. of oil while the other varieties contained less than 50 per cent.

25. At Dhulia Spanish peanut was grown without irrigation on a rainfall of 22 inches and yielded at the rate of 2,086 lbs. of nuts per acre and the crop was worth Rs. 168-6-0 against Rs. 79-8-10, the cost of production. The kernels of this variety contained 50·72 per cent. of oil.

26. At Surat Spanish peanut was tried as an alternative row crop with cotton and also with jowár. In the former case the yield of nuts was 770 lbs. per acre and in the latter 896 lbs. per acre, but the experiment was vitiated owing to the damage suffered by both cotton and jowár from excessive rains in July, which necessitated resowing, which however was not very successful owing to the land having become packed and therefore not in a favourable condition for receiving seed.

At Dhárwár similar trials were made and the results indicate that this method of cultivation will probably be found quite practicable in the case of cotton, but jowár appeared to grow too tall, thus shading the groundnut plants and turning them yellow. In the case of cotton a yield of 453 lbs. of seed cotton and 426 lbs. of nuts, together worth Rs. 67, was obtained leaving a net profit of Rs. 50 per acre, while in the case of jowár a yield of 1,719 lbs. of jowár grain and 142 lbs. of nuts, together worth Rs. 81-12-0, was obtained leaving a net profit of Rs. 50-1-9 per acre.

27. Irrigated groundnuts did not do well at Surat in the season under report owing to excessive rains in the month of July which delayed sowing operations. The average yield of the six best varieties was slightly below 2,000 lbs. of nuts per acre. At Dhulia Virginia and Large Japanese varieties did best as an irrigated crop. These were twice irrigated and matured in a little less than 4½ months. These varieties yielded at the rates of 2,680 and 2,677 lbs. of nuts respectively per acre. The values of their produce were worth Rs. 212-9-1 and Rs. 209-10-8 respectively, while the cost of production was Rs. 124 per acre.

Tobacco.

28. At Nadiád several varieties of tobacco have been under trial. These were all of the class suitable for producing cigar wrappers. Experience has shown however that the conditions prevailing at Nadiád are not favourable for producing leaf of very thin texture and mild flavour and steps have therefore been taken to obtain seed of the best American tobaccoes suitable for cigarette and pipe purposes. At present the local variety as it is put on the market

is quite unfit for such a purpose; while on the other hand there is a rapidly growing demand for a tobacco suitable for converting into cheap cigarettes, and efforts will now be concentrated upon trying to meet this demand.

29. Experiments in barn curing tobacco are being continued. One of the chief difficulties hitherto met with has been the extremely dry atmosphere and hence a steam generator has been installed during the course of the year.

30. A report received from the Imperial Institute, London, upon some Nadiád samples pointed out that they were deficient in burning quality due to the exceptionally low proportion of potash present in the leaf. The ash of good burning tobaccoes of the same class should contain 20 per cent. of potash, whereas the best of the Nadiád samples contained only 9·6 per cent., while the other samples contained much less. An experiment with potash manures has accordingly been laid out with the object of seeing to what extent the potash content of the leaf can be increased by high manuring with potassic fertilizers. The presence of chlorine in the leaf adversely affects its burning quality and hence potassium chloride has not been included among the potash yielding fertilizers. Potassium nitrate has also been excluded, while potassium carbonate (in wood ashes) and sulphate of potash are included in the experiment.

31. This crop was tried for the first time at Dohad in the year under report. Seed was obtained from Nadiád and the results were quite satisfactory. The yield of cured leaf per acre was 2,244 lbs. worth Rs. 168-4-10; but the cost of production proved rather heavy, amounting to Rs. 131-10-8.

Potatoes.

32. At Belgaum cut sets have given better yields than whole sets, whether the original potatoes were large or small; but it was observed that plants raised from whole sets grew more vigorously than those derived from cut sets and became taller and thicker in the stem, and it would seem that this excessive stem growth has reduced the production of tubers. It was further found that cut sets obtained from large potatoes gave better results than cut sets derived from small potatoes.

33. The use of sprouted sets resulted in an increased yield of over 20 per cent. and moreover the germination of the crop was both earlier and more regular and the crop was thus ready earlier for the market, a point which greatly adds to the value of the produce.

34. At Nadiád potatoes again did badly, and it is becoming more and more evident that this crop can only be raised by sweet water—the water in the Nadiád well is relatively salt, containing 150 parts of salt per 100,000 parts of water, of which more than half is sodium chloride.

At Dohad the crop was tried for a second time but did badly.

Tapioca.

35. This crop has been tried at Surat, Nadiád, Dohad, Dhulia and Dhárwár, but at none of these places does it give any promise of doing well. At Surat the soil is a heavy black clay and the sets were planted early in July and the tubers were dug out in the following June 1910, but only 203 lbs. of green tubers were obtained from 124 plants on an area of 7¼ gunthas giving the poor acre yield of 1,120 lbs. The crop was not irrigated. It was observed that the plants remain stunted and the tubers do not develop well in strong black cotton soil and the results are considered conclusive.

At Dhárwár the crop was planted in July and the tubers dug out the following July 1910, but the yield was only at the rate 2,652 lbs. of green tubers per acre. The maximum weight from one plant was 10 lbs. 12 ozs., while the average weight was 3 lbs. 9 ozs. The crop was grown in black soil without irrigation. It was found that cattle eat the leaves of this plant, so the crop requires protection.

At Dhulia the crop was planted in medium black soil. The weight of green tubers from 47 plants was only 55 lbs., whilst the highest yield from a single plant was 2½ lbs.

At Nadiád the crop was planted in July and taken up in the following hot weather. The crop was not irrigated and the plants did not grow very vigorously. The average weight of green tubers per plant was 2 lbs. The crop suffered from wild pigs and there does not seem much prospect for it in Northern Gujarát.

At Dohad the crop yielded at the rate of 4,160 lbs. of green tubers per acre.

Miscellaneous Crops.

36. Varietal experiments are in progress with the more important pulses and oil seeds. At Dohad heavy yields have been obtained with Khándesh tur (1,710 lbs. per acre), local gram (1,990 lbs. per acre) and Surat vál (1,445 lbs. per acre). Selection with the object of purifying mixtures, increasing the yields, and obtaining disease resistant strains is also being carried out upon these crops.

Manures

37. The residual effects of a heavy dressing of crude night-soil applied six years ago to a piece of black cotton soil at Surat have again been very pronounced in the year under report when the cotton was the crop grown. Statement I below summarizes the results obtained in the year under report from which it will be seen that the night-soil plots have given very heavy yields amounting from one and a half to twice the yields obtained on the plots manured with farmyard manure. Statement II gives the average results of the three jowár crops and three cotton crops taken since the manures were applied. These figures show a very remarkable increased outturn in the case of cotton grown on the plots treated with night-soil while there is also a very substantial increased net profit. The average figures for jowár also show increased outturns ranging from 400 to 700 lbs. of grain per acre, while the increase of kirbi is fully 50 per cent. over that produced on the plots manured with farmyard manure and the additional net profits run from Rs. 10 to Rs. 21 per acre.

STATEMENT No. I.

Showing the results of Night-soil Manure on Surat Farm during the year 1909-10.

Name of manure.	Sub-Division.	Crop.	Yield per acre.			
			354 Seed cotton.	355 Seed cotton.	356 Seed cotton.	Average yield of 3 plots.
Night-soil in beds (84½ carts) ...	A	H. cotton.	829·4	812·9	725·4	789·
No manure in 1904-05 but 20 carts of farmyard manure in 1905-06	B	Do. ...	406·4	414·3	404·3	408·3
40 carts of farmyard manure in 1904	C	Do. ...	469·6	429·7	498·0	465·9
Night-soil in trenches (84½ carts).	D	Do. ...	705·3	556·13	690:10	650·14

STATEMENT No. II.

Showing the results of Night-soil Manure Experiment for six years on Surat Farm.

Serial No.	Crop.	Quantity and kind of Manure.	Cost of manuring.	Yield per acre during the years														Average cost of cultivation.	Average value of produce.	Profit or loss.
				1904-05.		1905-06.		1906-07.		1907-08.		1908-09.		1909-10.		Average.				
				Grain.	Stalks.	Grain.	Stalks.	Grain.	Stalks.	Grain.	Stalks.	Grain.	Stalks.	Grain.	Stalks.	Grain.	Stalks.			
			Rs. a. p.															Rs. a. p.	Rs. a. p.	Rs. a. p.
1	Jowár ...	Night soil in beds 84½ carts per acre.	76 15 9	2,723	7,888	...	...	1,220	3,961	...	...	1,569	3,052	...	...	1,837	4,970	26 4 10	85 7 3	59 2 5
...	Jowár ...	No manure in 1904-05 but 20 carts of F. Y. M. in 1905-06.	13 1 0	1,886	6,278	...	...	715	1,419	...	...	620	1,213	...	...	1,074	2,970	15 10 10	50 2 10	34 8 0
...	Jowár ...	F. Y. M. 40 carts in 1904-05	28 7 2	2,156	6,537	...	...	931	1,876	...	...	769	1,434	...	...	1,285	3,299	18 3 10	59 13 0	41 9 2
...	Jowár ...	Night-soil in trenches 84½ carts per acre.	76 13 5	2,166	7,201	...	...	1,334	3,722	...	...	1,226	2,743	...	...	1,575	4,585	26 5 2	4 6	48 0 4
2	Cotton ...	Night-soil in beds 84½ carts per acre.	76 15 9	...	...	52	...	...	...	898	...	...	...	789	...	580	...	24 4 10	65 4 0	40 15 2
...	Cotton ...	No manure in 1904-05 but 20 carts of F. Y. M. in 1905-06.	13 1 0	...	...	142	...	...	...	513	...	...	...	408	...	354	...	13 10 10	38 13 2	25 2 4
...	Cotton ...	40 carts of F. Y. M. in 1904-05.	28 7 2	...	...	161	...	...	...	638	...	...	...	465	...	421	...	16 3 10	47 5 10	31 2 0
...	Cotton ...	Night-soil in trenches 84½ carts per acre in 1904-05.	76 13 9	...	...	88	...	...	...	847	...	...	...	651	...	529	...	24 5 2	59 8 2	35 3 0

Cost of cultivation of Jowár is taken at Rs. 13-8-0 exclusive of manure.

Cost of do. Cotton is taken at Rs. 11-8-0 do.

38. At Surat poudrette is producing good results both when directly applied to cotton and as a residual manure upon jowár. Experiments with poudrette at Dhárwár upon cotton and jowár are also leading to good results. This manure applied to jowár has greatly increased the yield of that crop, the extra value of the produce amounting to Rs. 18-6-2 per acre against an extra cost of Rs. 10 per acre, but it is anticipated that this poudrette

will exercise a considerable residual effect upon the next season's cotton crop. One advantage noticed about poudrette was that it quickly forces the crop into good vigour thus enabling it to withstand the attacks of borer (Chilo simplex) to a greater extent than the crop on the other plots. The high yield of kirbi on a plot manured with poudrette is also very noticeable.

39. Experiments at Nadiád indicate that the most economical manure for tobacco for increasing its yield is a combination of farmyard manure and castor cake. The net profit per acre on the plot manured with 20,000 lbs. of farmyard manure plus 600 lbs. of castor cake has exceeded that of the plot manured with 30,000 lbs. of farmyard manure only by Rs. 35-3-4 per acre in the case of shallow cultivation and by Rs. 25-7-4 per acre in the case of deep cultivation.

It was further observed that in the case of the plots manured with farmyard manure supplemented with castor cake the leaf cured very well.

40. At Belgaum the substitution of safflower cake for a part of the usual dressing of farmyard manure proved successful; the yield on the plot treated with 9 cart-loads of farmyard manure plus 2 cwt. of safflower cake was at the rate of 15,890 lbs. per acre, while that on the plot manured with 15 cart-loads of farmyard manure only was at the rate of 14,350 lbs. per acre.

41. A small application (10 lbs. of nitrogen) of sulphate of ammonia has slightly increased the net profit on cotton at Dhárwár while the new fertilizers calcium cyanamide and calcium nitrate promise well for jowár.

At Dhárwár a cwt. of sulphate of ammonia, both when used alone and in conjunction with sulphate of potash has increased the yield of jowár. Ammonium sulphate, 2 cwt. per acre, upon the potato crop at Belgaum, appeared to be benefiting the crop as it stood in the field but the outturn obtained was unsatisfactory thus indicating that the growth of stem and leaf was rather too much stimulated.

42. At Surat the average results for the last 4 years show that the yields of cotton jowár and til can be very greatly increased by the use of sodium nitrate in connection with superphosphate. The average increases have been—

30	per cent. in the case of	cotton,
19	do.	jowár,
25	do.	til,

but in spite of these large increases in yield there has been no increase in net profits. During the same period farmyard manure has alone improved the yields by—

19	per cent. in the case of	cotton,
19	do.	jowár,
50	do.	til,

leaving the following increased net profits :—

Rs. 2-12-6	per acre in the case of	cotton.
Rs. 3-8-8	do.	jowár.
Rs. 3-4-4	do.	til (plus tur).*

Nitrate of soda used alone has not given good results, while nitre and castor cake each used alone have both greatly increased the yields of the abovementioned crops without increasing the net profits. It is interesting to note that none of these manures have shown much effect upon the túr (Cajanus indicus) crop which of course belongs to the order of Leguminosæ.

43. At Dhárwár nitre, nitrate of soda and calcium nitrate (applied in a small dressing of 10 lbs. of nitrogen per acre) have increased the yields of jowár at the rate of 12 to 17 per cent. over that of the control plot but the crop on these experimental plots was uneven owing to damage done by rats and by the borer (chilo simplex); however the jowár on the plots treated with the manures mentioned above was relatively better than that on the control (untreated) plot thus indicating that these manures performed their expected roll of acting as a stimulant upon the crop.

44. At Dhárwár superphosphate both alone and in conjunction with sulphate of potash plus ammonium sulphate has greatly increased the yield of jowár kirbi.

45. The capacity of black cotton soil to produce fair crops for a long series of years without manure of any kind provided the tillage is good has been again well illustrated in the year under report. Thus the average yield of jowár on plots 388 and 389 during the season under report was 1,135 lbs. of grain, while the average yield of cotton on plots 413 and 414 was 332 lbs. per acre. None of these plots have received manure for the last 13 years and probably for a much longer period.

Note.—These crops are grown in rotation and the manures were applied every year to each crop until 1907-08; since then they have been applied only once in two years at the following rates :—

Nitrate of soda is applied at the rate of 100 lbs. per acre; Nitre at 160 lbs.; Superphosphate at 400 lbs.; and castor cake at 600 lbs., while farmyard manure is applied at the rate of 5 tons per acre.

* Grown as a mixed crop but as the tur on the farmyard manure plot was inferior in yield to that of the no-manure plot the increased net profit on til is really greater than indicated by these figures.

Tillage.

46. Experiments at Surat with deep ploughing, *i. e.*, ploughing with Ransome's C. T. 2 plough, in preparation for the cotton and jowár crops have shown the great necessity for carrying out the ploughing operations in the fair season, as soon after the previous crop is harvested as possible in preference to waiting till the monsoon sets in. Trials have been made under both conditions and in the case when the ploughing was done after the commencement of the monsoon the crops were inferior to those raised on plots which had only been harrowed according to the local practice. On the other hand when the ploughing was done in the fair season the results, although not quite reliable, are sufficiently interesting to mention here. The yield of the jowár crop was increased by 17 per cent. and that of the cotton crop by 10 per cent.

The reason why the deep ploughed plots have done badly when the ploughing was done after the rains set in is because the land is turned up in a rough condition and there is not time for it to become pulverised and reduced to a suitable tilth in which the seed should be sown.

47. At Dhárwár an experiment in deep ploughing for cotton and jowár was tried. The ploughing was done in the middle of May while the control plot was ploughed with the country plough on the same day. The cotton seed was sown on the 9th of August and the germination was good in both plots but subsequently some blanks in the deep ploughed plot had to be dibbled. No difference was observed in the plots in September but towards the end of October the deep ploughed plot appeared more vigorous. Ultimately the yield on the deep ploughed plot was at the rate of 620 lbs. of seed cotton per acre while that on the control plot was 548 lbs. per acre giving an advantage of 13 per cent. in favour of deep ploughing. In the case of jowár on the other hand the germination on the deep ploughed plot was very irregular, due probably to a sufficiently good tilth not having been secured, and the yield was poor in consequence. A similar result was experienced at Gadag in the case of kharif jowár.

At Dhulia deep ploughing for cotton did not prove beneficial in the year under report. The ploughing was done in good time in the month of March but probably the excellent rains tended to conceal the advantages of deep cultivation by supplying ample moisture to the ordinary cultivated plots.

Deep ploughing for tobacco continues to give good results at Nadiád. The yields of the crop have been increased by amounts ranging from 60 to 184 lbs. per acre of cured leaf, leaving an increased net profit of from Rs. 5 to Rs. 15-5-4 per acre.

50. The local method of sowing maize at Dohad is by hand behind a plough. This is probably to ensure the seed reaching the necessary depth to obtain sufficient moisture. This method of sowing was compared with drilling in the year under report with the result that the drilled plots yielded at the rate of 2,507 lbs. of grain per acre while the plots sown behind the plough yielded at the rate of 2,084 lbs. per acre.

51. At Surat experiments in the past have indicated that a good cotton crop can be raised by sowing as late as September The general tendency of the results obtained this year indicate that early sowing is preferable for both cotton and jowár.

52. An interesting experiment consisting of sowing the cotton seed in June in anticipation of rain, as is done in the Broach District, showed the risk attached to such a practice. The seed was sown on the 8th June and it germinated all right as the result of the first rains which fell on the 1st of June. The rain however was insufficient to carry on the young seedlings with the result that the crop perished for want of moisture.

53. At Dhárwár comparative tests indicate that early sowing for Broach is essential while the beginning of August seems to be the best time for Kumpta.

Rotations.

54. An experiment to ascertain the best rotation crop for cotton brought to notice the risk associated with many of the crops grown in Khándesh. The til crop gave only about a quarter of its expected outturn owing to rains holding off at the critical period and thus the profit from the two-year-rotation cotton-til was less than that from the cotton-fallow rotation which also proved superior to cotton-udid and cotton-bájri as udid practically failed owing to deficient rains in July and August while bájri was only half a crop owing to rain washing the ear-heads at the time of flowering and thus preventing the grain from setting. A remarkable feature about this experiment was the exceptionally good cotton crop on all the plots which amounted to close on 1,200 lbs. on the fallow rotation plot, while the lowest outturn was 835 lbs. of seed cotton on the udid rotation plot.

55. Owing to the high prices prevailing for cotton for several years past there is a tendency among cultivators in Khándesh to grow cotton for several years on the same land without rotation. Experiments at Dhulia show that provided the land receives good tillage very excellent crops can be raised at least for three consecutive years. In the season under report cotton yielded at the rate of 766 lbs. of seed cotton per acre on a plot which had grown cotton every year for three years without manure while a yield of 879 lbs. was obtained on a similar plot which received 2 tons of farmyard manure per acre each season.

56. At Dhárwár the best rotation crop for cotton is also under investigation. The beneficial effects of gram and the adverse effects of linseed were well illustrated in the year under report.

57. At Nadiád a rotation involving the three crops of bájri in the rains, potatoes in the cold weather and Sundhia jowár in the hot weather, all in one year, appears to be impracticable as the excessive quantity of irrigation water required by the latter two crops is apparently damaging the texture of the soil, for the yield of Sundhia on the plots treated in this way seems to be falling off.

58. The benefits of a good rotation for jowár were well demonstrated at Dhárwár in the year under report. The highest yield on the farm was obtained on a plot of medium black soil which had been cropped with black gram in the previous year and manured with 2 tons per acre of farmyard manure before the jowár seed was sown. The yield was 2,047 lbs. of grain per acre.

59. An experiment at Dohad proved that it is more profitable to take a crop in both the kharif and rabi seasons than to leave the land fallow in the rains and give it special tillage treatment so as to conserve the maximum amount of moisture and then to take a rabi crop of wheat. In the latter case the yield of wheat was greatly increased but not sufficiently so to compensate for the loss of the crop of maize in the kharif season.

60. At Dhulia one advantage of growing bájri instead of jowár as a kharif grain crop was illustrated in the year under report. It is that in a season of good rainfall a second crop of gram can be taken after bájri—a thing which is not possible in the case of jowár. Another point in favour of bájri was demonstrated in the year under report, *viz.*, the cotton crop grown after bájri proved to be greatly superior to that taken after jowár.

Eri-culture.

61. Experiments have been commenced with eri-culture at Dhárwár and Surat on a small scale and there seems to be some possibility of this becoming a valuable cottage industry in certain parts of the Presidency. The question of a market for the cocoons is the most important matter now as there does not seem to be any special difficulty in rearing the worms. The Imperial Entomologist is making experiments in collaboration with the Chhoi silk mills in Bombay and it is not definitely known yet whether there will be a demand for this class of silk by the mills; but even if there is not, the alternative system of hand looms can be resorted to.

Silage.

62. This fodder is prepared at Surat and Nadiád farms. At the former place 91,778 lbs. of green grass was put into the silo at the end of August and the silage was fed to cattle during the hot weather from the 1st April till the 8th June when 55,325 lbs. of excellent silage was obtained. The cattle appeared to like the silage very much and it kept them in very good condition. The cost of the grass including filling it into the silo was Rs. 241-15-0, thus making the rate approximately 230 lbs. per rupee.

At Nadiád 22,766 lbs. of edible silage was obtained from 38,243 lbs. of green grass filled into the silo in the middle of September. The silo was opened on the 12th March and the silage which was fed once a day to 8 cattle lasted until 9th August. The percentage waste is high on account of the long period the silo remained open. Had it been open for only a month the loss would have been much less. The cattle readily ate the silage and it kept them in good condition. The cost of production was at the rate of 218 lbs. per rupee. Ordinary Sundhia jowár fodder was selling at the rate of 60 lbs. per rupee in the hot weather when the silage came into use.

Crop Pests and Preventive Measures.

63. At Belgaum and Dhárwár a special series of experiments have been conducted in order to ascertain the most suitable and practical method for storing potatoes so as to protect the tubers from the ravages of the Potato moth (Lita solanella). The potatoes may become attacked either when they happen to get exposed in the field or when they are heaped in the stores as the moth lays her eggs in the "eyes" and the caterpillars which hatch out rapidly penetrate into the tissue of the tuber and destroy it. The preventive measures consisted of (*a*) preliminary treatment so as to destroy the eggs or the caterpillars which chanced to be on or in the tubers, and (*b*) proper storage so as to exclude subsequent attack by the moth. The more effective preliminary treatment proved to be fumigation with petrol at the strength of 4 ozs. per 16 cubic feet of space for 24 hours. Fumigation with benzine was also tried and did well. Steeping in kerosine emulsion and crude oil emulsion for 5 minutes, the strength of the solution being ½ pint of stock emulsion dissolved in 4 gallons of water, did not give such good results as the fumigation treatments. The methods of storage consisted of placing the tubers on racks in an insect-proof room keeping the potatoes in sacks, covering the potatoes with sand and keeping the potatoes between two layers of sand, etc. Those which were spread out on racks in an insect-proof room suffered only 2·5 per cent. loss from insect attack and ·5 per cent. from rot, while those stored in sacks suffered 5·3 per cent. loss from insect attack and ·6 per cent. from rot, those stored between two layers of sand suffered 18 per cent. loss from insect attack and ·5 per cent. from rot, while those stored between two layers of straw suffered 25 per cent.

loss from insect attack. Probably the most practical method of storage is therefore to fumigate the tubers with petrol and then store them in sacks taking care to turn the potatoes out regularly at intervals of 3 weeks and to remove the diseased ones. By this method less than 1 per cent. were lost by rot at Belgaum whilst loss of weight by shrinkage due to driage appears to be diminished.

64. The rice crop at Belgaum was severely attacked by grasshoppers (Hieroglyphus furcifer). Special attention was paid to this pest and it was found that the only practical preventive measures were those of a mechanical nature. Catching the hoppers in nets proved very successful.

65. Grasshoppers did great damage to crops in many parts of the Karnátak and Khándesh but the Dhárwár Farm crops were scarcely affected by this pest. At Dhulia however a good deal of damage was suffered especially by the fodder variety of jowár, Sundhia.

66. At Nadiád and Dohad Kátra-hairy caterpillars (Amsacta lineola F.) appeared in enormous numbers in July and destroyed the young crops of bájri, kodrá, maize, castors, til and pulses, etc. The Nadiád Farm crops suffered comparatively little damage but the surrounding cultivators' crops were seriously destroyed. Even the roadside trees were left leafless and it was impossible to walk through the fields without killing thousands.

67. White ants continued to do great damage at Nadiád especially to cotton and wheat.

68. Stem borer (Nonagria uniformis) did a good deal of damage to wheat at Dhárwár.

69. At Dhárwár castors were severely attacked by semi-looper (Ophinia maleciste) but persistent hand picking kept this pest in check.

70. Udid and Múg were severely attacked by aphides at Dhulia but spraying with kerosine emulsion proved effective.

71. At Dhulia rats did considerable damage to sugarcane and wheat while at Dhárwár the jowár crop in its early stages was much damaged by rats. Efforts to poison and trap these vermin did not prove very successful.

72. At Dhárwár there was a severe outbreak of rust. The wheat became attacked about the beginning of January and the disease spread very rapidly so that after a week's time scarcely a plant had escaped attack. Rust did great damage to the wheat crop on the Nadiád Farm and in many parts of Northern Gujarát particularly in the Ahmedabad District where irrigated wheat is grown; in many fields the yield of wheat was not even a two annas crop.

In Khándesh and at Dhulia there was very little rust.

73. At Dhárwár a considerable amount of damage was done to jowár by the disease known by the name chikta which affects the ear-heads causing a viscous sugary discharge which prevents the proper formation of the grain. The Imperial Mycologist reports that this disease is caused by a fungus which belongs to the order of Hypocreaceæ of the Ascomycetæ and he suggests that the seed should be steeped in half a per cent. of copper sulphate for 12 to 16 hours before sowing as a preventive measure.

74. At Dhárwár the potato crop was destroyed by a fungoid disease *; the colour of the branches and stem turned pale and brown and the leaves curled up and withered causing the death of the plants. The inside of the tubers was found to be in a slightly rotten condition but there was no marked offensive smell.

75. The sugarcane crop in the Jalálpur Táluka of the Surat District suffered considerable damage from red rot (Colletotrichum falcatum Went).

Seed Distribution.

76. Large quantities of seed have been distributed to cultivators during the course of the year as well as to the other Agricultural Departments.

Cotton.—At Dhárwár 20,000 lbs. of Navsári (Broach) seed was obtained from Gujarát and distributed in different parts of the Karnátak. 4,600 lbs. of local Kumpta seed was also distributed; while about 1,500 lbs. of hybrid (Kumpta × Kumpta) cotton was distributed, of which 458 lbs. was distributed in the Bágalkot Táluka of the Bijápur District. 42 lbs of Cambodia cotton seed was distributed among cultivators near Gadag. In Gujarát 7,550 lbs. of hybrid cotton seed and 3,758 lbs. of selected Surat-Broach cotton seed was distributed among cultivators.

In Khándesh 1,769 lbs. of cotton seed was distributed.

Groundnuts—Nearly 4,000 lbs. of groundnut seed was distributed in Karnátak, about 4,600 lbs. in Gujarát and 3,160 lbs. in Khándesh.

78. Special arrangements were made to supply the Belgaum potato growers with good pure Italian seed. The Divisional Inspector, Southern Division, was deputed to Bombay to purchase the best seed as soon as it arrived in port; 130 bags were purchased and these were rapidly forwarded to Belgaum by special arrangement with the Railway companies. Potato seed was also obtained from Surat for distribution in the Dhárwár district.

* Not as yet identified.

79. Considerable quantities of jowár, sann and tur seeds were also distributed in the Karnátak while seed of Perio and Sundhia jowárs was distributed in Gujarát.

Well Boring.

80. Well boring operations in Gujarát were in progress from September till the end of June. In addition to the four existing complete plants of Cawnpore boring apparatus one more plant was added in the course of the year while the Executive Engineer for Surat and Broach Districts has purchased 4 new plants for his Department. Three boring plants were kept in the Kaira District and one each in the Ahmedabad and Surat Districts. Altogether 30 wells were bored in the Kaira District, of which half proved successful; the most promising locality being Borsad Táluka and the adjoining Umeta State. In Borsad Táluka there were 7 successful borings and 3 partially successful borings in the vicinity of Virsad village while there were only three unsuccessful borings. A few successful borings were made in the Nadiád Táluka but all the borings in the Anand Táluka proved unsuccessful. In Umeta State out of 6 borings 4 were successful and 2 partially successful. In Ahmedabad District little success has attended boring work in the Dholka and Viramgám Tálukas but this is due to the great depth of the sub-soil water which in some cases is 300 feet below the surface. In Daskroi Táluka the water level is nearer the surface. Boring in the Surat District was on a restricted scale but all the 6 wells bored proved successful. The depth at which water was met with varied very greatly. The depths of successful borings ranged from 6 feet to about 90 feet. Beyond that depth no success was obtained although some borings were carried down to beyond 100 feet while in one case a depth of 131 feet was reached. In Broach District one well was bored which proved a success. Altogether 53 wells were bored, of which 56 per cent. proved successful. In the case of all these borings with the exception of three wells in the Daskroi Táluka of Ahmedabad the coolie charges were paid by the well masters and in addition when the boring proved successful the well master paid the wages of the mukádam in charge of the work and the cost of the piping. The average cost of labour came to Re. 0-13-4 per foot against Rs. 1-7-0 in the preceding year. Up to the 31st March 1910 the total expenditure for the year under report was Rs. 5,285-12-4, of which Rs. 2,326-1-9 was incurred in the purchase of tools. During the same period Rs. 1,284-13-8 was recovered from well masters whose wells were successfully bored so that the net cost to Government was Rs. 4,000-14-8.

Introduction of improvements to the notice of cultivators.

81. Owing to the appointments of Divisional Inspectors it has been possible to greatly extend this line of work. On all the farms under my charge including Gokák, Gadag and Belgaum demonstration days were held when large numbers of cultivators assembled. These demonstrations took the form of showing the people round the farms and explaining to them the objects of the experiments. Improved agricultural implements including iron ploughs, the Olpád threshing machine, chain pumps and chaff cutters, etc., were all practically demonstrated. At several of the farms oil engines and pumps were also shown at work. In Gujarát the Cawnpore boring apparatus was demonstrated. Methods for the destruction of crop pests and the prevention of crop diseases were shown such as the netting of grasshoppers and the steeping of cereal seeds in copper sulphate solution. At some of the farms the methods of eri-culture were explained, while at Surat the management of a breeding herd and dairy were fully explained. Lectures on important agricultural matters were delivered and subsequent discussions upon these and other subjects raised by cultivators took place. Advantage was taken of the Jalgaon Exhibition and the several shows held throughout the year to give similar demonstrations to those mentioned above and these have been driven home by a series of village to village demonstration.

82. In the Karnátak a large number of such village demonstrations have been very successfully given in connection with the Poona method of making gul. In this Division the process of boiling gul is very crude and the best juice is frequently wasted by being converted into semi-fluid dirty dark coloured gul while the pans in use are about 2½ feet deep and made of thin iron sheets which cause the juice to burn when there is a slight excess of heat; the furnace is nothing but a round pit some 4 feet deep with no exit for the escape of smoke and owing to the lack of sufficient air the fuel is wasted by being only partially consumed and hence a large amount of fuel has to be purchased costing from Rs. 10 to Rs. 15 per acre of sugarcane. At Mugutkhan-Hubli the gul made by the Department was sold at the rate of Rs. 18 per *her* (200 lbs.) against Rs. 16 for the gul made by the local method, while on the other hand no extra expenditure was required for the purchase of fuel.

83. Another important village demonstration was that made with the Olpád threshing machine in West Khándesh and Northern Gujarát. At the village of Nizer in Nandurbár Táluka which produces 1,500 acres of wheat annually this thresher was worked for a couple of days. Two heaps of 1,200 bundles of wheat were threshed respectively by the Olpád thresher and the local method of treading out by cattle. The work was completed by both methods in one day but while the former method required only 2 bullocks and 3 men the local method required 18 bullocks and 6 men. The bhusa produced by the machine was found to be as good as that produced by the treading system and in one respect it was superior as by bullock treading the leafy portion becomes too finely powdered which is not liked by cattle whereas this does not happen in the case of the machine.

84. The large quantity of seed distribution is another important piece of district work which takes up much of the time of the Divisional Inspectors who have not only to explain the advantages of the same but often are obliged to demonstrate the best methods of cultivation while the arrangements for marketing the produce is frequently a very heavy piece of work. At Dhárwár an auction sale was again successfully organized for the disposal of Broach cotton grown in the Southern Maratha Country at which some 800 *nágas* (1,344 lbs. each) of seed cotton were put up for sale and realized Rs. 1,11,455-12-7. At Surat arrangements were made with the Gulam Baba Mills to purchase the seed cotton grown by cultivators from hybrid and improved cotton seed distributed by the Department. This seed cotton was worth Rs. 11,644 and the cultivators got Rs. 142 per *bhár* (924 lbs.) for it, which was 5 per cent. above the rates prevailing for local cotton.

85. Numerous demonstrations of how to steep cereal seeds in copper sulphate solution to prevent smut, and with artificial manures have also been given in the villages. A number of demonstration in the use of the net for catching grasshoppers upon rice and jowár were given in the Belgaum and Dhárwár Districts.

86. Work in co-operation with Agricultural Associations is another important piece of district work which is increasing. The Kumpta Association provided a piece of land for the Department to conduct demonstrations with groundnuts and potatoes. The Bijápur Association has opened a small demonstration farm for similar purposes to be managed under the advice of the Department. The Dhárwár Association has been assisted in procuring implements and seed for distribution. Assistance of a similar nature has been given to Agricultural Associations in Khándesh and Gujarát.

T. F. MAIN,
Deputy Director of Agriculture.

APPENDIX II.

SUMMARY OF EXPERIMENTAL WORK UNDER THE PROFESSOR OF AGRICULTURE, 1909-10.

Sugarcane.

The permanent experiments with regard to rotation, the more economical methods of manuring and irrigation have been continued. Cane crushing, sugar making, preparing gul by different systems have been under investigation. A beginning was made in studying the factors which determine the quality of gul.

1.—Rotation Experiments.

The necessity for carrying on these experiments was fully discussed last year (see Director of Agriculture's Annual Report, page 33).

These plots were laid down in 1907. This being only the 3rd harvest it is too early yet to expect much results from a rotation experiment.

So far in the experiment the taking of jowári fodder crop in the fourth year is more profitable than either leaving fallow the land which is to be planted in January with cane or even than ploughing in a crop of san.

Manure Experiments.

(*a*) Trials of mineral nitrogen manures :—Ammonium sulphate alone as a top dressing and in combination with safflower cake also as a top dressing was experimented with.

The plots had previously received about 45 carts of farmyard manure furnishing 200 lbs. of nitrogen and 150 lbs. of nitrogen was furnished in the top dressing. The weight of cane was considerably higher on the plots treated with ammonium sulphate. One thousand lbs. of safflower cake to 3 cwts. of the ammonium sulphate seems to be the best combination. This dressing costs practically the same as the safflower cake and gave about 1,000 lbs. more gul per acre.

Crude nitre was used in one plot to supply half the nitrogen used in the top dressing. The outturn was about the same as in the case of the sulphate but the dressing cost Rs. 30 more per acre.

(*b*) Experiments to find out the best combination of safflower cake and farmyard manure : The plots with only 300 lbs. of nitrogen gave equal results with those on which more was applied.

Reducing the farmyard manure to $\frac{3}{4}$ of the usual amount, but keeping the top dressing of safflower cake as usual, did not affect the outturn.

(*c*) With safflower cake alone.

Here again 300 lbs. of nitrogen gave the same outturn as more. The outturn was equal to that of the plots where farmyard manure was used in combination with safflower cake, the cost for manure being a little lower.

(*d*) Different times of applying the top dressing.

No advantage is seen from this year's plots in applying the top dressing in two applications.

(*e*) Potash and phosphoric acid experiments.

The nitrogen manure of this series was as usual 350 lbs. from farmyard and safflower cake.

In addition, plot 1 received superphosphate, plot 2 potash, plot 3 potash and superphosphate, plot 4 nothing.

The complete manure plot (No. 3) produced 2,400 lbs. more gul than the unmanured and the potash plot considerably more. The part played by potash and phosphoric acid in sugarcane manuring in our Deccan trap soils needs more careful investigation. Phosphoric acid alone has never given any increase but when used with potash it seems to pay.

(*f*) In Bombay Presideney nearly all sugar is marketed as gul or gur (jaggery). This is prepared in open pans over a brisk fire.

Gur plays a very important part in Indian cookery and the demand for it is considerable. This commodity sells from 10 lbs. to 20 lbs. per rupee averaging about 15 lbs. A good sample contains about 75 per cent. crystallized sugar (succrose) and is of golden brown colour. A beginning was made this year to study the qualities of gul and the factors of production which control them such as soil, manure, season of growth, age of harvest and method of preparation. The work was beset with many difficulties. The chief difficulties being lack of a suitable

method of determining when the cane is ripe, the lack of a standard method of preparation and proper methods of judging the comparative values of the different properties as hardness, colour, grain (crystallisation), taste and keeping qualities.

Under these circumstances and also because serious demands were made upon the Mánjri staff for Poona furnace demonstration and sugar making at the critical time, very little in the way of certain conclusions can be drawn from the results of the year. But so far as the figures obtained indicate anything they show that of the manures tried, farmyard manure produces the best quality closely followed by poudrette, fish and safflower cake come next and are about equal while castor is a little poorer. When used as a top dressing with farmyard fish gave considerably more crystallizable sugar than the other manures, while safflower cake, castor cake and nitre were about equal, ammonium sulphate being considerably poorer in this respect.

Heavy soil produced better gul than the lighter ones. When the period of growth was kept constant the season of planting had little effect upon the amount of sugar in the juice, but the outturn was considerably less in canes planted after the middle of February.

There is a belief amongst cultivators that certain manures affect the colour of the gul, such as safflower cake producing greenish gul and fish manure red gul. Although the tintometer was used no definite conclusions were arrived at.

(*g*) At Bárámati much heavier dressings of manure are given than has been found profitable on the Mánjri Farm. An experiment was carried on at Bárámati to see whether smaller dressings would not pay better. The site chosen was in the salt affected area although the land itself did not appear to have been affected to any great extent. It is the local practice near Bárámati to apply about 50 carts of farmyard (40,000 lbs.) and 16 pullas (3,840 lbs.) of oil cake containing in all about 800 lbs. of nitrogen. This dressing certainly gave on this experimental area a more profitable outturn than the lighter dressing containing 350 lbs. of nitrogen found best at Mánjri. The amount of irrigation water used here is about 400,000 cubic feet per acre while at Mánjri the best results have been obtained with about $\frac{3}{4}$ of this amount of water. While I have no occasion to doubt the validity of our results I am far from believing that the manurial practices of Nira Valley are in any way the most economical.

In no other part of the sugar world are such enormous applications of nitrogen made as in Poona District. Mr. Mollison's first work with sugarcane was in the direction of lowering the amount of manure. If a dressing costing Rs. 100 can be substituted for the present expenditure of Rs. 200 per acre and as high an outturn obtained, a saving of 7 lacks will be effected to the cultivators. This is shown to be possible from our outturns at Mánjri with only 350 lbs. of nitrogen having often exceeded, 13,000 lbs. which is equal to the yield at Bárámati under the best conditions. Surely it is a pity to give up the study of such an important question at the present stage as is proposed.

A beginning was made this year in the study of the most economical system of manure for sugarcane under well irrigation. Four experiments were carried out in Válva Táluka, in Sátára. In this region the land is prepared for sugarcane by application of from 25 to 30 carts of farmyard manure and by sheep folding and no top dressing is usually given. Karanja and saffower cake and ammonium sulphate were tried. The results are highly satisfactory, the increase being worth nearly Rs. 50 over and above the cost of the dressing over the usual outturn.

Irrigation Experiments.

These were carried out at Bárámati. The quantity usually applied was found from work of the Irrigation Department to be about 400,000 cubic feet per year equal to a rainfall of 110 inches in addition to the rainfall of about 2 inches. Plots treated with $\frac{3}{4}$ and $\frac{1}{2}$ the quantity respectively gave as high an outturn as the full quantity. This confirms the results of last year. The experiments with regard to interval are also in line of last year.

Intervals of 8 or 10 days gave practically the same quantity of gul; but when the interval was increased to 12 days the loss was about 2,000 lbs., when the interval was reduced to 6 days no gain in outturn was obtained.

These results and those at Mánjri in previous years show that 200,000 cubic feet of water equal to 55 inches of rainfall exclusive of the rainfall is quite enough irrigation to produce the highest crop if it is absolutely certain that water is available every 10 days.

Sugarcane Crushing.

The cost of crushing at Manjri by power and making gul amounted this year to Rs. 0-12-4 per pan of 1,000 lbs. of juice while the local rate by contract was Rs. 1-3-0. To the former interest and depreciation must be add d.

The percentage of extraction by this mill averaged 70 per cent. The 6 roller mill and plant at Bárámati crushed and boiled at Re. 0-12-4 per pan when working continuously Two

new crushers by Squires of Buffalo, New York, were purchased. By the appointment of an Agricultural Engineer these went from my charge but I understand that the one installed on Ráo Bahádur Kenjale's estate worked satisfactorily.

Groundnuts.

Variety experiments were carried out at 4 centres besides on the Farms. Good yields were obtained at all these centres except at Islámpur. Big Japan and Virginia are identical These varieties gave as an average 3,200 lbs. of nuts (green weight) Pondicherry 3,400 lbs. and the small varieties 2,060 lbs. The large ones are the most profitable under irrigation where there is plenty of water, but as a rain crop or where the water available is limited Mauritius or even the smaller varieties are more useful.

Two new varieties Egyptian and Mauritius were tried. These are about equal to the Pondichery as yielders.

Manure experiments were carried out at four centres. Lime 2,000 lbs. per acre, ashes 2,500 lbs. per acre, crude nitre 448 lbs. per acre, potassium nitrate 332 lbs. were compared with farmyard manure at 10 cart-loads. These dressings cost Rs. 10, Rs. 6, Rs 15, Rs. 11-3 and Rs. 10 to Rs. 15, respectively.

The Islámpur and Ahmednagar experiments are inconclusive; but at Kasegaon and Sholápur both the nitre and potassium sulphate plots gave an increase of from 25 to 60 per cent. above the farmyard manure plots. Ashes at Sholápur gave 55 per cent. increase while at Nagar the same manure gave a less yield by 16 per cent. than farmyard manure. Lime alone increased the yield from 16 to 50 per cent.

Groundnut being a potash feeder is greatly benefited by such manures as were used.

Bájri.

The awned bájri which we have been working with for the last ten years now produces about 80 to 90 per cent. awned ears. This strain of bájri is very much less attacked by birds than the ordinary varieties. It is hoped that by continued selection it will become pure enough to justify distribution in a year or two.

Jowári.

The experiments with this crop consisted of the trial of kharif jowárs in the Nira Valley as a substitute for rabi jowári and the experiments in seed steeping.

In the first series:—1 Chapati, (2) Sholápuri, (3) Gidgap, (4) Perio and (5) Utávali were tried and yields obtained as follows:—2,127 lbs., 1,444 lbs., 1,180 lbs., 760 lbs. and 469 lbs. respectively. On these small plots the attacks of birds were very serious.

Smut Experiments.

Two plots each of 4 gunthas were sown with ordinary jowári seed. Plot 1 was steeped in one per cent. solution of copper sulphate for 10 minutes while the second was unsteeped. 17½ per cent. of the heads of plot 2 were smutted while about one-fourth of one per cent. were only affected in plot 1.

Rice.

The ráb work at Lonávla was continued. Heated soil again gave good results, and the application of ashes gave a considerable increase over no treatment; there can be no doubt but that both heat and ashes are responsible for the beneficial effects of ráb. Heat is perhaps the more important factor of the two. No further light on the question of the reasons for the benefit of heating was obtained from the field experiments.

Other treatments were tried as substitutes such as cowdung as manure, earth saturated with urine from the byres, poudrette, oil-cake, nitre and soil pulverization. Of these oil-cake costing about Rs. 16 per acre, urine earth at Rs. 8 per acre, nitre at Rs. 17 per acre, poudrette at Rs. 2 per acre gave a higher yield than ráb which at Lonávla cost Rs. 12 per acre. Urine earth and poudrette are the cheapest, whilst oil-cake produces the highest yield, 350 lbs. more paddy, than from the ordinary ráb being obtained. Cowdung ráb gave about 150 lbs. more paddy than ordinary branches ráb. One-half the weight of cowdung used as ráb when ploughed into the soil gave within 234 lbs. as much as the whole quantity used as ráb. From the above it is seen that as heavy crop can be raised with other treatments as by ráb and at a less cost. It is recommended that the substitutes mentioned below be used in the following quantities per guntha of seed-bed.

Cow manure ploughed in:—5 0 lbs. well rotted and thoroughly mixed with the soil, if possible immediately after the harvest.

Oil-cake 50 lbs. thoroughly pulverized and thrown broadcast just before sowing.

Poudrette 200 lbs. well mixed with the earth.

Urine earth 1,000 lbs.

Crude nitre 20 lbs.

Wheat.

The wheat grown at Mánjri suffered very much from rust. But the Australian crosses 22 and 27 and Sufed of Amritsar gave yields of over 1,600 lbs. when ordinary Kála Kusal only produced one-half this amount. They are worth pushing as an irrigated wheat in the canal irrigated tract.

Paman of Sirsa, Hansia, Broach, and Siadas gave yields of over 1,300 lbs. while Kála Kusal, Potia Nadiád, and Hybrid Nagpur, gave less than 800 lbs. and Shet Párner which is a dry wheat gave only 447 lbs. These varieties are not adapted to this tract.

The Gokák method of dibbling wheat on ridges was again tried and a considerable gain in outturn obtained ; the extra cost of sowing is made up in the saving of seed.

Soil moisture conservation experiments (dry farming).

These experiments which were begun last year were transferred to a plot near the city of Ahmednagar for more convenient supervision. The land was acquired too late to plough it before the early May rains, so deep ploughing gave less results than was expected. Experiments with firming the ground just after sowing with a roller improved the germination very much, but the benefit was not persistent.

Intertillage experiments showed a considerable gain from this operation. In the case of 18″ drill a gain of 30 per cent. and with 9″ drill of 16 per cent. was obtained of grain at an extra cost of Rs. 3 per acre. Thinner seeding gave the most striking result of any of these experiments. With the ordinary 9″ 4 coultered seed drill there was a gain in grain of 75 per cent. when only ½ the usual amount of seed was used and of over 40 per cent. with ¼ the seed rate. This gain in grain however was accompanied by a slight loss of 10 per cent. of Kadbi, but the quality of the latter was not seriously affected.

In the inundation experiments plots at Khadambe, Ráhuri Táluka, Nagar District, 3 acre gram and 5 acre cotton were sown.

These gave yields of 289 lbs. and 572 lbs per acre respectively. The gram at first looked very fine, but later was badly attacked by plant lice during a long cloudy spell which reduced the yield very much; neighbouring fields scarcely got any grain at all. The cotton was ordinary local variety and gave a yield of 572 lbs. per acre of seed cotton which is more than double the usual crop of the region.

At Khadambe the inundation is effected by throwing a small bund across a Nála and diverting the water to the plots which had previously been surrounded by low bandhs.

Similar experiments were carried on at Mánjri and Bárámati ; only canal water was used, the object being to prove that good rabi crops could be grown with irrigation water given during the kharif season at kharif water rates with perhaps one later watering only. At Mánjri, Khapli produced 2,173 lbs. of wheat, Australian 1,014 and Kanur Páthár 847 which may be considered as good yields.

The plots at Bárámati were too near the salt affected area for this kind of treatment to succeed.

Implements.

Ploughs.

Ransomes D. T. plough and Cockshut plough were tried on heavy soils. The latter proved very effective and a shipment has been ordered. They cost about Rs. 60 each.

Scrapers or Levellers.

An iron road scraper was tried and found superior to any other leveller for moving dirt to any distance. Others have been obtained. They are available at Rs. 16 to Rs. 22 according to size.

Norwegian Harrow or Clod Crusher.

This implement works well for reducing clods but the implement is too heavy ; a lighter one is in process of construction.

Chain Pumps and Bullock Gears.

Several types of these have been obtained and comparative trial will be made as soon as the proposed testing station for irrigation implements is ready.

Less was effected in investigations during the year than was hoped for, as much of the staff was engaged for a considerable time with the 7 exhibitions that we helped at and the numerous demonstrations undertaken.

J. B. KNIGHT,
Professor of Agriculture.

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APPENDIX III.

Summary of Expermental Work under the Deputy Director of Agriculture in Sind, 1909-10.

Season 1909-10 has been on the whole successful and the various lines of work as laid down in the former year have been followed out. As has been repeatedly pointed out elaborate experimental work is quite out of place in the present state of agriculture in Sind but it is of the greatest importance to get the ordinary rules of good cultivation observed.

The organisation of the Department has further developed during the past season. The main idea is to get central stations in the chief representative tracts and cover the intervening country with a chain of sub-stations and demonstration plots. So far the central stations are established at Mirpurkhás and Sukkur and estimates are sanctioned for a station at Lárkána; work on which will probably be started in the present year. For the sub-stations, three are in working order in South Hyderabad, three in North Hyderabad, three in Sukkur and Upper Sind Frontier and one in the Nára Valley. This leaves Lárkána and Karáchi Districts. These will be treated in a similar manner probably in the following year. For demonstration purposes for getting in touch with zemindárs these sub-stations are essential, and they are undoubtedly the most important branch of the work in Sind. Results have first to be obtained on the central farm and are then carried out on the sub-stations in a manner easily and quickly assimilable. For the purpose land is lent by zemindárs, generally about 10 acres, and seed and haris are supplied by the Department.

Rotations and Leguminous Crops.

The chief points demonstrated on all the sub-stations are the advantages of rotations and cultivation of pulse crops instead of the present system of extended bare fallows. All the common Bombay pulses are grown and there are a large number suitable for both kharif and rabi cultivation. The cultivation of Tur (Cyjanus Indicus) is gradually spreading.

Berseem (Trifolium Alexandrium).

The success of the year has undoubtedly been the successful demonstration of berseem cultivation where rabi water is available. This is a matter of immense importance. In Sind it is simply a question of time and money till the existing irrigation canals are replaced by properly designed canals supplying water all the year round. Under these conditions with the cultivation of berseem two crops a year can be obtained without impairing the fertility of the land. With present system even if water be available, at most, one crop in two years is the utmost that could be taken. The rabi water-supply in the Jámráo was good and over 200 acres of berseem were sown at the Doulatpur Reclamation Station. It grew luxuriantly and when sown in October gave three cuttings and from two to three maunds of seed per acre. There is always a scarcity of fodder towards the beginning of the new year and green berseem sold readily at Rs. 12 per acre. Some hay was made and baled, it was sold at the rate of Rs. 19 per 1,000 lbs. At present the Jámráo area is the only district where water is available; as soon as Sind grown seed is available a large area of berseem will undoubtedly be cultivated. As showing the importance in which berseem cultivation is held in Egypt the following extract from the Official Text Book of Agriculture is interesting :—

Extract from Official Text Book of Egyptian Agriculture.

"It is impossible to overestimate the importance of the effect which berseem has on Egytian soils. In the first place the mechanical condition of the soils has been improved and when vegetable matter is incorporated in our heavy clay soils it opens them up making them more light and porous. For the improvement of light sandy soils no better system is known than that of growing berseem which not only enriches these in nitrogen in which they are generally deficient but also by the addition of vegetable matter, renders these more absortive and retentive and greatly enchances their value. In Egypt there is a great want of organic matter and were it not for the system of indirect green manuring practised by the ploughing in of berseem it is difficult to see how the fertility of our soils could have been maintained."

Cotton.

Egyptian cotton has not been sown in the year under report except on the farm at Mirpurkhás. Its produce was valued by Alexandria brokers as follows :—

"Afifi" Nice clean cotton but a little light in colour. Fair staple but rather coarse and irregular. Some pieces show fairly long regular fibre whilst others are short and wasty.

It is hard to judge the strength owing to the dryness of the sample.

Value is about 1/8*d.* per lb. over fully good fair Afifi equal today to 14*d.* per lb.

The yield of lint is 34 per cent., a very good outturn, but perhaps the seed has shrivelled owing to dryness in transport which might make a difference of ½ per cent.

"Abassi" cotton is clean and of good colour but staple is coarse and therefore lacks strength. Staple is shorter than it should be, and in quality like Abassi the fineness and length of staple is essential.

We doubt if your Abassi would fetch more than your Afifi today.

Yield of lint 33 per cent.

(Signed) S. R. P. CARVER.

American Cotton.—Upland American cotton seed was distributed in South Hyderabad and where it received fair treatment was successful. Yields of from ten to eleven maunds per acre were obtained and it has been shown that with similar treatment to Sind cotton the yield is good and sown at the same time, *viz.*, beginning of June on the Indus flood the American cotton has a somewhat shorter growing period. Small quantities were sown in Upper Sind and matured satisfactorily. Dhárwár-American was sown in the Nasarat tract and gave satisfactory results. So the first step in demonstrating that a good grade of Upland American can be grown under average treatment in the districts has been successful. It is however useless trying to push the cultivation to any extent without buying agencies being established. Local cotton merchants will not touch anything but Sind cotton. With Sind cotton selling at Rs 10 per maund for forward delivery the present is not a suitable time for getting the cultivation taken up Three tons of seed of Boyd Prolific have been obtained from America for distribution next year. The following is the valuation of American cotton by the British Cotton Growing Association, Manchester:—

"I now have very much pleasure in enclosing report on the different samples of cotton, which are most satisfactory. Cotton of any of these types, if produced in commercial quantities, could be readily sold at satisfactory prices in Lancashire and in any quantity. You will notice that the lowest in price, namely, Boyd's Prolific, is worth 20 points more than 'middling' American, and over $\frac{3}{4}d.$ more than 'Fine Broach.' Quotations for 'middling' American and Fine Broach are given at the botton of the valuation. As is pointed out by Messrs. Wolstenholme and Holland, these are just the quality of cotton required by Lancashire.

"I will let you have a report on the percentage of lint to seed by a later post. It would be interesting to know the weight of cotton produced per acre, so that one could form some idea as to which quality would be most suitable for cultivation. It often happens that the shorter stapled cottons, although fetching a lower price, may, by increased yield, be more profitable to the cultivator than the longer stapled cotton requires more care in cultivation, but in this connection I must point out that there seems to be every probability of a very high price being realised for long stapled cotton, owing to the scarcity of such cotton in America and also to the partial failure of the Egyptian crop."

(Signed) P. HUTTON,
Chairman.

COPY.

Liverpool, 14th February 1910.

"We enclose valuation of samples of cotton grown from American seed in Sind, Mirpurkhás, India, on Government Farm.

"We are pleased to say that the quality is excellent, and very suitable for the English market. As the cotton is ginned, you will know the percentage of outturn if they have gone through your own gin. This is just the cotton required by Lancashire."

(Signed) WOLSTENHOLME & HOLLAND.

Copy of Brokers' report on samples of American cotton received from the Deputy Director of Agriculture, Sind.

Black Rattler.—"Strict Good Middling in grade, good colour, staple $1\frac{3}{16}$ inch, little irregular, fairly strong, value 9·25*d.*" Yield of lint 33·37 per cent.

Peterkin.—"Fully Good Middling, staple $1\frac{1}{16}$ to $1\frac{1}{8}$ inch, fairly strong, value 8·50*d.*" Yield of lint 33·30 per cent.

Griffin Variety.—"Fully Good Middling, staple $1\frac{5}{16}$ inch, inclined to be tender, value 11·00 @ 11·50*d.*" Lint 30·0 per cent.

Boyd's Prolific.—"Strict Good Middling, staple $1\frac{1}{16}$ inch, fairly strong, value 8·40*d.*" Yield of lint 31·23 per cent.

Triumph.—"Fully Good Middling, staple full $1\frac{1}{8}$ inch, rather soft, value 8·60 @ 8·70*d.*" Yield of lint 35·71 per cent.

Toole Variety.—"Fully Good Middling, staple 1⅛ inch, fairly strong, value 8·60*d.*" Yield of lint 33·33 per cent.

Allen's Improved Long Staple.—"Fully Good Middling, good colour, staple fine, rather irregular, inclined to be soft, value 10½*d.* @ 11*d.*" Lint 30·56 per cent.

Texas Big Boll.—"Fully Good Middling, good colour, staple 1⅛ inch, strong, value 8·60*d.* @ 8·70*d.*" Yield of lint 31·25 per cent.

(Signed) WOLSTENHOLME & HOLLAND.

"Middling American," value 8·20/100*d.*

"Fine Broach," 7·9/16.

SINDHI COTTON.

So far, from tests of over 300 varieties of cotton from all parts of India none have been shown to equal the local Sindhi as regards cropping power. The ginning percentage has been improved on the Jámráo area by the action of one cotton gin agent in distributing seed grown near Hálla which is of a better quality. The sub-stations in North Sind and Sukkur Farm are demonstrating on the best varieties of cotton for Upper Sind and other districts where cotton is not at present grown In fact, at present cotton cultivation is confined to parts of Hyderabad and Thar and Párkar districts. There is a strong belief prevalent that cotton cannot be grown in the south of Sind near the sea or in Upper Sind in Lárkána, Sukkur or Upper Sind Frontier. There seems no reason to doubt, however, from the results of experimental work already carried out that cotton cultivation can be successfully pursued in any part of Sind. It is chiefly a matter of water and using the proper variety. There seems to be a very large scope for increasing the area under cotton in Sind with the consequent advantage to the country.

In connection with Sind cotton an attempt was made to see what the result would be when cultivated in a similar manner to Egyptian cotton. The usual practice is to broadcast it with as a rule very poor preparation of the soil, and thereafter it may receive one hoeing with the *kodar*. In part of Mirpurkhás Farm Plot E. 9 the land was ridged and the seed sown by hand. It was then thinned and treated like Egyptian cotton. The total yield worked out 1,683 lbs. of seed cotton per acre or 20 maunds and 63 lbs. It was sold at the rate of Rs. 10 per maund. In 1906 a yield of 12½ maunds per acre was recorded and in 1907, 16 maunds. It is certain that Sindh cotton responds vigorously to careful cultivation and especially to a supply of available nitrates as provided by berseem growing in rabi. So far the best yield of Egyptian cotton has been 6 maunds and of American cotton 7½ maunds.

CEREALS.

Three varieties of jowárs introduced from Surat have proved themselves on the whole considerably superior both in yield of grain and straw to any local varieties yet obtained in Sind. They are Chapti, Perio and Sholápuri. Yields of these varieties grown in the 2-year rotation at Mirpurkhás are as follows per acre:—

Year.	Local jowár.			Sholápuri.			Perio.			Chapti.		
	Plot.	Fodder.	Grain.	Plot.	Fodder.	Grain.	Plot.	Fodder.	Grain.	Plot.	Fodder.	Grain.
		Lbs.	Lbs.		Lbs.	Lbs.		Lbs.	Lbs.		Lbs.	Lbs.
1909 ...	C. 5	8,549	457	C. 2	9,474	632	C. 3	7,958	589	C. 4	7,684	716
„ ...	C. 9	5,779	190	C. 6	8,947	674	C. 7	7,886	674	C. 8	6,842	600

The fodder has been for the last few years much more valuable than the grain. At the beginning of the season the fodder is generally sold at about Rs. 12 per 100 bundles or about 3,000 lbs. At the end of the season the price has generally advanced to Rs. 25—30 per 100 bundles.

Selection work with wheats has been continued and a number of good strains are being distributed.

ALKALI EXPERIMENTS.

At Doulatpur results have worked out according to estimate and there is at present 200 acres of cotton growing on the station. The berseem in rabi was excellent and the station is now also fulfilling the second object of its establishment as a practical demonstration of how a zamindári estate should be worked, in addition to the primary object of *kalar* work.

MISCELLANEOUS.

Irrigation experiments on dry crops are being conducted at Mirpurkhás and with rice at Sukkur.

During the year a constant supply of green forage has been kept up at Mirpurkhás Farm. It has been found easy to maintain a regular green feed by growing berseem from October till April and the rest of the year using jowár, sawan (*Pennisetum crus-galli*) and chola or cow-peas. The importance of this is obvious after seeing the ordinary state of cattle in Sind in most districts especially during the cold weather.

In manurial experiments on wheat the great importance of thorough summer cultivation for the wheat crop has been brought out.

Trials of new crops, etc., are mentioned in detail in Farm reports.

SUKKUR FARM.

This station has been laid out and a cropping scheme fixed and partially commenced. The land was rough and salt, but after it has been all cropped in the coming rabi with berseem it will be fit for starting on with experimental work. An 8" centrifugal pump has been fixed on the river Indus and driven by a 8 H. P. portable steam engine. The necessary buildings have been erected.

Garden and Fruit Trees.

At Mirpurkhás a number of good varieties of fruit trees have been planted. They were obtained from Poona and Sáháranpur. The most successful are peaches, apples, plums, apricots, citron family, grapes and mangoes. There is a great demand for cuttings from zamindárs and a number have already been distributed.

Shows, Lectures, Seed and Implement Distribution.

Successful Shows were held at Shikárpur and Talhár. Demonstrations and lectures were held in various parts of Sind, generally in connection with sub-stations or exhibitions of working implements.

Altogether 49 demonstrations were held, estimated to be attended by 2,662 people.

During season 1909-1910, 2,336 lbs. of cotton seed and 9,389 lbs. of seeds of all other kinds were distributed.

From the workshop at Mirpurkhás the following implements were made and distributed during the season:—

Implement.	Made during 1909-1910.	Total since the workshop was started.
Ploughs	238	325
Scrapers	52	82
Norag or threshing machines	15	17
Ridging boards	48	109
Yokes	17	34
Archimedian screw	1	2

G. S. HENDERSON,
Deputy Director of Agriculture, Sind.

APPENDIX IV.

Report of the Agricultural Chemist for the year 1909-1910.

1. The office and laboratory of the Agricultural Chemist to the Government of Bombay have been in my charge during the whole of the year under review. Owing to pressure on the space in the buildings of the Agricultural College, the work was conducted, for most of the time, with very limited accommodation. Before the end of the year, however, it was possible for the laboratory to obtain the use of the greater part of the space which it is intended ultimately to occupy.

2. The routine analytical work of the laboratory is constantly increasing, as the following figures, which indicate the number of samples received in each of the last four years, show :—

Kind of sample.	Number of samples examined.			
	1906-1907.	1907-1908.	1908-1909.	1909-1910.
Soils	67	101	311	347
Manures	43	105	91	205
Feeding stuffs	17	41	17	107
Water	22	80	266	403
Gul and sugar	32	76	7	56
Beetroot	...	...	36	11
Oils and oilseeds	47	98	146	278
Milk	233	666	257	546
Condensed milk	...	...	2	...
Cream	123	1	1	...
Butter and ghee	2	2	2	16
Tapioca	...	...	...	46
Miscellaneous	10	22	17	104
Total ...	596	1,192	1,153	2,119

These figures show a very marked increase in almost every class of sample.

3. By far the larger proportion of these samples are received from the various farms and offices of the Agricultural Department. There are, however, a continually increasing number of inquiries addressed and samples sent from private individuals in all parts of the Presidency. As I remarked in last year's report, this is really the test of the success of the work. So long as little else than departmental work is done so long must it be considered that only half the purpose of the laboratory is being served. It is only when it becomes the place to which cultivators send their difficulties, or merchants buying and selling agricultural products send these products for analysis, that one can feel it is fulfilling its purpose. The number of samples which have been received from private individuals and firms during the last three years is as follows :—

	1907-1908.	1908-1909.	1909-1910.
Soils	15	14	23
Manures	12	11	11
Feeding stuffs	3	2	17
Water	11	16	15
Milk	...	4	17
Butter and ghee	...	...	13
Miscellaneous	...	7	41
Total ...	41	54	137

The progress in the direction of being utilized by the general agricultural public is, therefore, very considerable during the past year.

4. One of the things which the samples received illustrate is the search which is going on at the present time for new oilcakes for manure. Several were sent to me which have not been much used hitherto, and perhaps the figures of the analysis in these cases may have some interest.

(*a*) This sample is of *undi* cake, made from the seeds of *Calophyllum inophyllum*, a common plant in the Konkan where the oil is employed. The cake is no use for feeding,

but its analysis, given below, seems to indicate that it may be a manure of very considerable value. At present it is principally used only as fuel.

(*b*) The second sample is of *burlim* cake, really a safflower cake, but under a new name. It proved to be one of the best samples I have had in my hand.

(*c*) A third sample was called *wánki* cake, and was also received from below the ghâts. It is really produced from *Salvadora persica*, and also forms a manure of very considerable value.

The analysis of these samples gave figures as follows :—

	Undi cake.	Burlim cake.	Wánki cake.
	Per cent.	Per cent.	Per cent.
Nitrogen	3·77	8·12	4·79
Potash	1·50	0·93	2·85
Phosphoric acid	1·73	1·03	1·05

5. Another material which seems from its analysis to be capable of some local development is mhowra refuse, produced in large quantities at the distilleries established in several centres. The sample analysed was from Mundhwa (Poona) in a very highly cultivated district, where any addition to the manure supply would be particularly valued. The figures of the analysis are as follows :—

	Per cent.
Nitrogen	1·04
Potash	1·83
Phosphoric acid	0·84
Moisture	79·50

The material was very wet, but when dry it would appear to be distinctly a valuable manure.

6. A matter of some interest which has occurred during the year has been the commencement of the importation of molassine meal or 'molascuit' into the Presidency from Australia. This material, made from the refuse molasses of sugar factories and the pith from inside of the sugarcane or some similar material as an absorbent, makes an excellent food, as the following analyses shew :—

	Per cent.
Moisture	13·58
Oil	·12
Albuminoids	2·45
Sugar	17·13
Other soluble carbohydrates	52·59
Woody fibre	6·26
Ash	7·87
	100·00

It has for a long time seemed a pity that such material should not be made in our sugarcane districts, where there is a considerable amount of waste of sugar-containing material. Acting on my suggestions, Mr. G. N. Sahasrabuddhe of the Mánjri Experimental Station has, during the year, devised a method capable of being used by any cultivator, however small, for preparing a very valuable feeding material from the pith of the sugarcane and the scum from the *gul* boiling pans which is now almost entirely wasted.

The material obtained gave an analysis as follows :—

	Per cent.
Moisture	5·44
Oil	4·30
Albuminoids	7·29
Sugar	17·66
Other soluble carbohydrates	45·15
Woody fibre	9·73
Ash	10·43
	100·00

This material was relished by the cattle, and will form a valuable addition to the fodder available in and near the sugarcane tracts. As prepared so far, it does not keep well in the

rains, but there is no difficulty at other times of the year. A leaflet has been issued describing the method of preparation.

7. There has been an attempt to find an outlet for banana or plantain flour during the year, but so far it has failed. A large fruit and sugarcane grower in one of our irrigation tracts offered to supply ten tons per annum of plantain flour of excellent character, if a market could be found to it. The material was very good as the following analysis indicates :—

	Per cent.
Moisture	6·44
Oil	1·79
Albuminoids	5·64
Soluble carbohydrates, starch, &c.	82·91
Woody fibre	·36
Mineral matter	2·86
	100·00

A great deal has been said about plantain flour in recent years, and I asked the Director General of Commercial Intelligence to assist in finding a market. Advertisements were issued, and as much as possible was done to make the fact known that the material was available. So far not a single offer has been received, and we can only conclude that there is no market. But the material is good, and is available to the extent named if any demand exists or arises.

8. Another material which might be used as a feeding stuff and which came before me during the year is the seeds of *tág* or *tanged* (*Crotolaria juncea*) which is grown to a considerable extent for fibre. The only objection to these seeds is a slightly objectionable taste which cattle do not like at first. They are commonly used as sheep food, and might be used for other animals, as they were fed with success to the dairy cattle at the Government Civil Dairy at Kirkee. On analysis these seeds gave the following figures :—

	Per cent.
Moisture	2·93
Oil	4·10
Albuminoids	34·85
Soluble carbohydrates, &c.	44·84
Woody fibre	8·95
Ash	4·33
	100·00

9. Among samples sent to my laboratory for examination none are more frequent than those of wells which have just been dug for irrigation purposes, or which have apparently done damage to the land on which they have been used as irrigation waters. It seems, in fact, astonishing what a large number of wells on the trap areas of Western India contain a considerable amount of salts. Luckily in most of them the salts are chiefly Sodium Sulphate and Sodium Chloride, and with fair drainage little harm is done by these salts unless they are present in large proportion. When Sodium Carbonate, even in small proportion, occurs, then the danger of damage becomes very much greater on account of the disastrous effect which it has on the condition of the land. In a case near Málegaon in the Násik district, a series of wells gave analyses as follows :—

	Parts per 100,000				
	1	2	3	4	5
Total salts ...	110·0	120·0	76·0	80·0	82·0
Sodium Bicarbonate ...	26·7	23·2	27·8	25·7	27·8
Sodium Chloride ...	30·0	18·5	21·3	27·7	27·7
Sodium Sulphate ...	3·6	3·6	3·6	3·6	3·6
Sodium Nitrate ...	28·2	47·8	...	...	...

All of these had caused damage to the very excellent land on which they were put.

This case is not an isolated one, and it is one of the most difficult matters in dealing with irrigation from wells in the Deccan to know what to do in such cases. In the above case it is probable that high manuring, or the burying of organic matter in the form of green manure regularly and frequently will very largely neutralise the evil effect of the Sodium Carbonate in the waters, but there are a number of cases where conditions are worse and where the waters are almost useless. I mention the matter here because there is always a danger that when wells are deepended they will become more salt. This will, in fact, be the result in most cases, and it must seriously affect any question of extensive and serious deepening of wells on the Deccan trap area.

10. Such were just a very few of the more interesting questions raised by samples sent to my laboratory by the public during the year. With the very large number sent from the officers of the agricultural department, I leave their senders to deal.

11. I may now turn to the other section of the duties of the Agricultural Chemist to the Government of Bombay, namely, the investigation of special chemical problems in connection with agriculture. This has largely consisted of a continuation of the study of those detailed in my last year's report. One of these, namely, a study of the methods for dealing with the question of the development of salt and barren land in the Nira Valley irrigation area, has been practically completed, and a bulletin on the subject is now in the press, and will be issued almost immediately. In that I have been able to show that the development of salt, barren areas, is entirely or almost entirely due to the rise in the sub-soil water to an unhealthy extent, caused by the impossibility of the seepage water from the canal being able to get away by the natural drainage channels. The most serious part of this question is the rapid extension of the area which is taking place, and the fact, which I have shown that there is already much salt in the *good* land. This latter results in the use of very much larger quantities of manure and water than would be otherwise required. Successful and possible methods for prevention of the extension of salt land and for the reclamation of the areas now barren have been worked out and are described in the bulletin already mentioned.

12. The first instalment of my study of the effect of heating on the soil in connection with the question of '*rab*' for rice is almost ready for issue. The results confirm the statement made in my last report which I may perhaps repeat here. It appears clear, in fact,

(*a*) that the heating of the soil is the chief factor in the value of '*rab*' about two-thirds of the effect can be obtained by the heating alone;

(*b*) that there is no virtue in the particular method adopted in heating the soil. If it be scraped from the surface and heated in a kiln with about one-fourth of the fuel, an equal result will be obtained;

(*c*) that the heating causes three principal changes in the soil—

i. The alteration in the number and proportion of the different bacteria in the soil.

ii. The making soluble of a considerable amount of organic nitrogenuos matter in the soil.

iii. The improvement in the physical condition of the land.

"Which of these causes is the dominant one I am not yet prepared to say, but the results indicate that both (i) and (iii) take a part."

13. Of other matters under investigation, I may say that the first instalment of a study of the varieties in the composition of the milks of Indian cows and buffaloes done in conjunction with my predecessor, Mr. A. A. Meggitt, is almost ready for the press. Another study of the sources of loss of sugar in *gul* manufacture is in a similar position. It is needless to refer in detail to other matters, but it may be stated that the following questions are under investigation;—

(1) The variation in the composition of well waters according to season in the trap areas.

(2) A survey of the well waters in certain areas.

(3) The composition and purity of the *ghee* sold in Indian bazaars.

(4) The composition of *pán* (betel vine) leaf, and the nature of its active principles.

14. My staff have worked very well throughout the year, and in addition to doing the necessary routine work, have each taken up a special problem as their own personal investigation under my guidance. Mr. Price, the senior laboratory assistant, has been superintendent of the laboratory throughout the year. Mr. Tamhane has been chiefly engaged on the investigation of the salt land question and has worked very hard and successfully. Mr. N. V. Joshi, who was specially working at the '*rab*' question, has been transferred to Pusa during the year, and his place has been taken by Mr. N. V. Kanitkar. Mr. D. M. Ranade, B.Ag., has joined the laboratory staff during the year.

HAROLD H. MANN,
Agricultural Chemist.

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APPENDIX V.

Summary of Experimental Work done under the Economic Botanist, 1909-10.

Ganeshkhind Botanical Garden, Kirkee.

The season on the whole was fairly good though the rabi rainfall was disappointing. The development of the garden and experimental work have gone on steadily. The Natural Order Section is now being extended. None of the rubbers have done well; Ceara rubber, of which hopes were at one time entertained, has proved unable to stand the dry hot months. Jute has been grown giving a yield of 682 lbs. dry fibre per acre, valued at Rs. 5-4-0 to Rs. 5-8-0 a maund. Of the other fibre plants grown, plantain and sisal gave interesting results. Fibre was extracted from these with a small hand machine of French make called the Duchemin machine. Varieties of edible plantains gave only 0·4 to 0·8 per cent. of dry fibre. This fibre is being tested and valued. Shaded sisal grew much larger in leaf than unshaded sisal, but gave practically the same percentage of fibre. The difference, if any, of the quality of the fibre is being investigated. Various cottons have been grown in the garden and comparisons made with those of previous years. The yield of Bourbon has decreased, but the quality is still very good. The soft Peruvian has increased in amount and is of excellent quality. Dhárwár-American and Dhárwár-American hybridised with Ghogári have deteriorated in quality and quantity. Cambodia did well; Bhuri and Lálio only moderately. Several other plants were used for fibre extraction. One Dombeya Mastersii gave the enormous percentage of 40 per cent. of fibre. Its qu lity appears from rough inspection to be moderately good. Thirty-two new species or varieties of useful or ornamental plants were introduced into the garden during the year from all parts of the world. It was proved that lucerne grass made a good silo. An experiment was carried out to determine the yield of flowers, fibre and seed from Rozelle. This came to 448 lbs. dry flowers, 552 lbs. dry fibre, and 384 lbs. seed, all per acre, sown broadcast.

The garden has been one of the centres for the Economic Botanist's research on the conditions affecting wheat rust. This research is now in its second year. Enough data have been gathered to warn the publication of a separate paper on this work. Several lines of work on tapioca are being pursued. Unirrigated tapioca with a 23-inch rainfall stands no comparison with irrigated tapioca. No prussic acid was found in the tubers of 6 plants examined every month from the time of appearance of tubers to harvesting. The shade of trees acts very prejudicially on tapioca causing it to grow long and lanky without tubers. Various plants have been tried as hedging materials for keeping out animals. Certain of these plants have been selected for further trial. The work on vines has been the combating of mildew at Ganeshkhind, Mundwa and Násik. The means used have been cleaning the trees of dead wood by careful pruning, and spraying with Bordeaux mixture. The results so far have been most satisfactory and are fully recorded in Bulletin No. 36 of 1910 of the Department. An attempt has been made to combat the Sursa (borer) disease of pomegranates by bagging the young fruits. This has proved fairly successful. If the cost of the bags can be reduced is likely to be of practical value. Weeds were left untouched for seven months in one line of pomegranates, but the fruits did not seem to suffer. Trench irrigation of pomegranates proved unsatisfactory, but ring and basin were both found useful. An attempt was made to cause the insects which fertilise wild figs to enter cultivated figs but the attempt was unsuccessful. The growth of papaya in different soils has been tested. It did better in medium black than in calcareous. Sub-crops between papayas (chillies and potatoes) did not seem to affect the papayas adversely, and gave useful extra value for the outlay on cultivation and watering. An astonishingly large proportion of papaya trees were males. An attempt is being made to select seed so that proportion of males may be reduced. Some hermaphrodite papaya trees have produced fruit. An experiment is being made to find if the character of hermaphroditism is heritable. Guavas have also been tested as to growth in different soil conditions. These also do better in medium black than in calcareous soil. Continuous layerings are being made to test the truth or otherwise of a local belief that this treatment produces seedless guavas. Selected guavas from various guava districts of the Presidency are being propagated. Experiments on budding 11 citrus varieties on Mahalung stock show that on this stock Mahalung buds take best and Kágdi limboo worst. The degree of success in budding is not apparently completely correlated with botanical affinity between stock and scion. Various observations have been made on mango diseases and published from time to time in the Poona Agricultural College Magazine. It was attempted to cross the Pairi mango with the Cawasjee Patel, but without success. The crop of mangoes was excellent. A small extra coffee plantation has been opened. A considerable number of insect pests were treated. The most useful remedies were crude oil emulsion for mealy wings on pomegranate and Jámbul and for aphis on oranges and cotton; and tobacco and soap emulsion for aphis on pomegranates and mahava on guava. Eri and Mulberry silk worms have been successfully reared throughout the year, though the cocoons show a tendency to decrease in size and fresh seed must therefore be got at least once a year. Silk eggs and various plants and seeds were distributed to many applicants. Several courses of teaching in horticulture aad silk work were given in the garden to students of the Agricultural College and others.

Botanical Garden, Bassein.

Further development of the garden has been carried out in the direction of reclamation of land and improving of water channels. The foundations of some of the wells unfortunately

show signs of giving way and there is still scarcity of water in the hot weather. One Persian wheel has been fitted up as an experiment with galvanised iron bandyas instead of the usual earthenware ones. Pundia sugarcane showed itself a heavier yielder than the green and red Mauritius but more liable to disease. The yields of cucumbers on trellis and coiled round poles were compared. There was no marked difference in the yields. An extensive collection of plantain varieties is being grown, and careful study of their times of flowering, quality of fruit, etc., is being made. The growth of rubber plants is simply being observed. Castilloas are doing fairly well. A large amount of lemon grass amounting in dry weight to about 2 tons has been grown and sent for distillation on a large scale in order to settle the question of its profitable commercial handling both as an oil-producing body and as a paper pulp. Bourbon cotton did not do well this past year, being very badly attacked by insect pests and suffering from its unfavourable surroundings in the fort. A collection of grafted mangoes has been planted out, and is being gradually extended. It is hoped thus to contribute something to our knowledge of these highly variable fruit trees. Budding the mango has so far been unsuccessful, but experiments are still being continued. There is one interesting double grafted mango in the garden. Some observations have been made on mango diseases. Grafts have been made of Anona reticulata and Zizyphus jujuba (Bor) and these are likely to give useful results. The growing of yams in raised beds proved a failure, as rats had a too easy access. Cocoas are growing slowly but remain healthy. They are between plantains and get the benefit of their shade and seepage of water. Jute grown as a rain crop without manure proved very poor and san hemp grown in the same way was also inferior. Wheat was grown in connection with the Economic Botanist's research on wheat rust. Four wheat varieties were sown and three of these were badly attacked with rust; the fourth moderately attacked. Groundnut gave two crops a year of good quality.

WILLIAM BURNS,
Economic Botanist, Bombay.

LIST OF AGRICULTURAL BULLETINS PUBLISHED BY THE DEPARTMENT OF AGRICULTURE IN 1908 TO 1910.

No.	Year.	*Subject.*	Price. Rs. a. p.
30	1908	Field, Garden and Orchard Crops of the Bombay Presidency, by G. A. Gammie, Economic Botanist, Bombay ...	0 12 0
31	1908	Establishment and Management of the Dairy Farm, by G. K. Kelkar, Assistant Professor of Agriculture ...	0 3 0
32	1908	Locusts in India, by H. M. Lefroy, Imperial Entomologist, Pusa ...	0 8 0
33	1909	Cultivation of Broach Cotton in Dhárwár, by M. L. Kulkarni, Divisional Inspector of Agriculture, S. D. ...	0 4 0
34	1909	Night-soil—A Valuable Manure, by G. K. Kelkar, Assistant Professor of Agriculture, Agricultural College, Poona ...	0 4 0
35	1909	Kalar in Sind, by G. S. Henderson, Deputy Director of Agriculture, Sind ...	0 4 0
36	1910	First Experiments in the Treatment of Grape-vine Mildew in the Bombay Presidency, by W. Burns, Economic Botanist	0 14 0
37	1910	An Examination of the Seed Supply of the Broach District, by G. D. Mehta.	0 4 0
38	1910	Experiments with the Water-Finder, by H. K. Mehta, Assistant Professor of Physics, &c., Poona Agricultural College	0 5 0
39	1910	The Salt Land of the Nira Valley, by Harold H. Mann, Principal, Agricultural College, Poona, and V. A. Tamhane, Laboratory Assistant, Agricultural College, Poona ...	0 5 0

Annual Reports.

Annual Report of the Department of Agriculture, Bombay Presidency, for the year 1909-10.

No. 715.

REVENUE DEPARTMENT.

Bombay Castle, 24th January 1911.

Letter from the Director of Agriculture, No. A.—7828, dated 1st November 1910—Submitting the Annual Report of the Department of Agriculture, Bombay Presidency, for the year 1909-10.

Letter* from the Director of Agriculture, No. A.—9110, dated 16th December 1910.

RESOLUTION.—During the year under report all the principal officers in the Agricultural Department and practically all the Superintendents of Farms were in uninterrupted charge of their posts. This has contributed greatly to the efficiency of the Department as well as to the interest of the reports submitted by the Director and the Principal of the Agricultural College and of the notes embodied in the appendices prepared by the Departmental experts.

2. There was no addition during the year to the number of stations in charge of the Department. Proposals have been approved for opening a Government Farm at Lárkána in Sind, and it is under contemplation to open an agricultural station in the Kolába District. Investigation was carried on in continuation and development of the lines followed during the previous year. As hitherto, cotton continued to be the most important crop dealt with, and the Department's experiments and operations in connection with it covered a wide range. They included the introduction of new varieties by importation and hybridization, the improvement of existing varieties by seed selection, trials of the effects of improved tillage, of rotations and of manures and the final marketing of the harvest in such a way as to secure to the cultivator the full value of an improved crop. In all these directions there have been achieved, and are in course of achievement, definite results of the utmost importance for the cotton cultivator and the cotton spinner. Thus at Dhárwár cotton grown from newly imported Navsári (Broach) yielded up to 27 per cent. better than the best yield of the local Kumpta on the Government farm. In addition the new cotton possessed a superior colour and had a markedly higher ginning percentage. The hybridized Kumpta grown in the same neighbourhood from distributed seed not only yielded better than ordinary Kumpta but sold for $7\frac{1}{2}$ per cent. more at the auction held by the Department. In the Surat District the price obtained by cultivators in the open market was 5 per cent. better under similar conditions of improved yield from distributed seed. In Sind the cultivation of Egyptian cotton was restricted to one farm. American varieties were tried with some success, but the most promising results were obtained with the Sindhi variety, which responded in a remarkable degree to more careful methods of cultivation. The conclusion suggested is that exotic cottons, even when carefully cultivated under favourable conditions, will find it difficult to make headway against the local Sindhi on account of the latter's superior cropping power.

3. Experiments were continued in the Presidency proper with jowári, bájri, wheat, sugar-cane, groundnuts, tobacco, potatoes, tapioca and miscellaneous crops. In Sind the success of experiments in the cultivation of barsim satisfied the Deputy Director of Agriculture that, wherever a perennial supply of canal water can be provided, the land can be made to bear two crops annually, without impairing its fertility. In his investigations in the use of ráb in the Presidency, Dr. Mann has now ascertained that the heating of the soil is the main factor and that about two-thirds of the whole effect can be produced by heating alone. It appears also that the effect of the heating is independent of the manner of applying the heat and that if the surface soil is scraped up and heated in a kiln with one-fourth of the quantity of the fuel used for ráb an equal result is obtained. Similar conclusions were reached by the Professor of Agriculture, whose experiments showed further that other and less costly methods can be employed to raise crops equal to those grown with the help of ráb. In view of the general scarcity of ráb materials and the difficulties which have been encountered, on the one hand, by the cultivator in his agricultural operations and, on the other, by Government in their endeavours to induce the cultivators to exploit the sources of

* Not printed.

the material in a provident fashion, it is essential that the effect obtained by other methods of treating the soil should be speedily confirmed and the results brought to the knowledge of the rice cultivators who are dependent on ráb for their manurial operations. Manurial experiments with other crops showed that ordinary farmyard manure is still the cheapest fertiliser available and that while the stimulating effects of mineral manures is very marked their price is ordinarily so high as to make their general use unremunerative at the present time. Government will await with interest further information on the subject of the deterioration by salt efflorescence of land under irrigation.

4. During the year an Agricultural Engineer was appointed and has proved of the greatest service in laying down sound lines along which the use of mechanical appliances for agricultural purposes must develop.

5. Substantial progress was made in the all important branch of the work of the Department which is concerned with bringing home to the cultivator a knowledge of the results attained and the means of applying these results in practice. It is most satisfactory to observe that Agricultural Associations are being constituted in all parts of the Presidency. These Associations, including 12 established during the year under report, now number 31. The most important of the new bodies, the Deccan Agricultural Association, supplements the Departmental bulletins, by the issue of a vernacular monthly devoted to the interests of agriculture. The associations co-operated with the Department in the instruction of the ryot by the organisation of agricultural shows, the distribution of implements and the superintendence of demonstration plots. Probably the best official encouragement which can be given to them is to stimulate their interest and activities by freely engaging their assistance in work of this kind. The agricultural shows held during the year numbered 17, of which 7 were organised by local associations and at all of which lectures, demonstrations and general assistance were liberally provided by the Department. The demonstrations on the Government farms have become a regular institution which is immensely popular with the substantial cultivator and arouses a keen and intelligent interest in scientific agriculture. As a consequence the new Divisional Inspectors find themselves readily approached for advice and assistance of all kinds.

6. The Agricultural College completed its second year as a separate institution, and as part of the new buildings became available for occupation at the beginning of the year the work was conducted under more favourable conditions than hitherto. The delay which has occurred in the construction of the students' quarters is to be regretted. When these and the main block of buildings are completed the College will be thoroughly well housed and equipped. The number of students working for the B.Ag. degree of the University showed a slight falling off during the year, but this was balanced by a satisfactory increase of special and short-course students. The Principal in paragraph 17 of his report has suggested that for some years to come a marked preference should be shown to graduates in agriculture for appointment to the Revenue service. As in the past Government will continue to make every endeavour to secure suitable employment for graduates who distinguish themselves in this branch of study. It must not however be forgotten that the primary object of the existence of the College is to create a body of trained agriculturists, from whose ranks the Department may draw recruits fitted to undertake the work of research and organisation, who will also be available for private employment by large estate owners, or, when opportunity occurs, by capitalists engaged in industries allied to agriculture, such as sugar refining and the manufacture of artificial manures, and who in some cases will apply their scientific training to the management of their own lands. The purpose served by the College as an educational institution in which a young man may be trained to observe and think with precision, and thereby be equipped for his after career, whether in Government service or in private employment, must necessarily be a secondary consideration.

7. The strong desire manifested at the Agricultural Conference held in September 1909 at Poona that the benefits of agricultural training should be brought closer to the peasantry by providing schools for those actually engaged in cultivation attracted the special notice of Government, and a beginning has been made by opening at Poona a vernacular school for the sons of cultivators where boys may be given a training in practical agriculture side by side with their ordinary education. It is gratifying to note that the class has made an excellent start and, as funds permit, it will be advantageous to extend the provision to other parts of the Presidency. On the other hand efforts are not relaxed to make good the educational deficiencies of the boys of agriculturists who desire that their sons should

take the full B.Ag. course of the College. The University regulations require that a candidate must have passed the Previous Examination before he can enter for the B.Ag. degree examination. This is a standard of education not frequently reached by farmers' sons, who are therefore unable to take advantage of the scholarships provided for their class at the College. Youths of the agricultural classes, however, not infrequently pass the Matriculation Examination, and to meet their case Government have extended the term of a number of the scholarships by one year, so that a boy who has passed the Matriculation is enabled to proceed to the Previous Examination preparatory to entering on the B.Ag. course at the College. Provision has also been made for admission to the full College course of those who are qualified to understand it but who cannot proceed to the University degree for want of a Previous pass qualification. Students of this class are specially examined on the University standard and given certificates, and the question of substituting a special degree for these certificates is at present under consideration. Government will relax nothing of their efforts in these and similar directions to bring the College course within the reach of the classes who have a natural aptitude for the study of agriculture, as well as to provide less advanced and theoretical courses for such as neither require nor can profit by an advanced scientific training.

8. The Governor in Council is pleased to express his great appreciation of the ability and zeal, tempered with sound judgment, with which the work of the Department in all branches has been guided and controlled by the Director. Government note with satisfaction the skill and sympathy with which Dr. Mann has conducted the College and the enthusiasm displayed by the able staff of experts who have assisted him. Mr. Henderson has continued his work in Sind with zeal, and the departmental organisation in that province has developed greatly under his guidance.

R. D. BELL,
Under Secretary to Government.

To

The Commissioner in Sind,
The Commissioner, N. D.,
The Commissioner, C. D.,
The Commissioner, S. D.,
All Collectors, including the Collectors and Deputy Commissioners in Sind.
} With one copy of the Report, and with an intimation that the requisite number of copies of it will be supplied to them by the Director of Agriculture.

The Director of Agriculture and of Co-operative Credit Societies,
The Settlement Commissioner and Director of Land Records,
The Conservator of Forests, N. C.,
The Conservator of Forests, C. C.,
The Conservator of Forests, S. C.,
The Deputy Conservator of Forests in charge Sind Circle,
The Colonization Officer, Jamráo Canal,
The Accountant General,
The Director of Public Instruction,
The Principal of the Agricultural College, Poona,
The Educational Department of the Secretariat,
The Political Department of the Secretariat,
The Public Works Department of the Secretariat,
The Financial Department of the Secretariat.
} With copies of the Report.

The Government of India,
The Under Secretary of State for India.
} By letter.

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